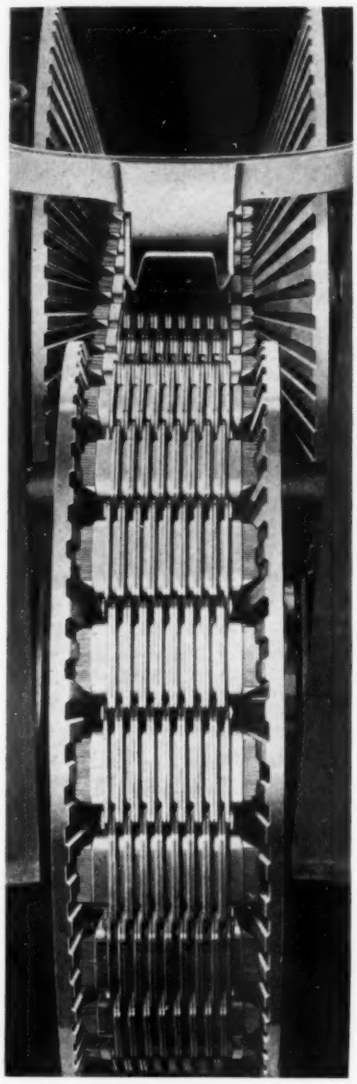
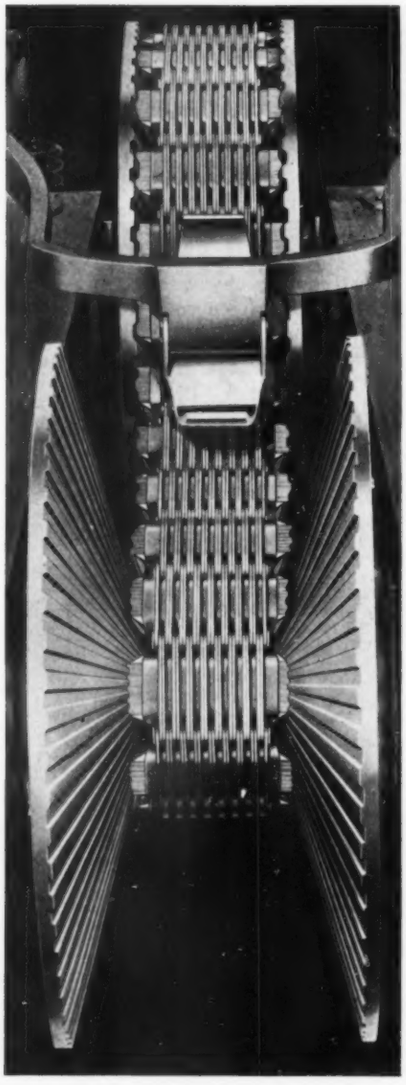


American Machinist

APRIL 22, 1936



A brand new set-up solves Link-Belt's problems in producing the P.I.V. Gear

▲

VERSATILE METHODS MAKE A VARIABLE DRIVE

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JOHN HAYDOCK
Managing Editor

SOME years ago, a young British engineer was given the job of trailing that elusive will-o-the-wisp of electrical engineering, the design of variable-speed a.c. motor. He did not achieve his original objective, but he did accomplish much the same result by mechanical rather than electrical means. The fruit of his efforts is today known as the positive, infinitely variable drive—P.I.V. for short.

This drive takes power from the prime mover, usually an electric motor, and transmits it to the driven machine by employing a familiar mechanism which uses a flexible member between two pairs of cones. The two halves of one pair of cones are brought together while those of the other pair are forced apart, causing a belt or chain to engage the cones farther from the shaft in one case and nearer in the other. The application of this principle as incorporated in the P.I.V. drive may be seen in the accompanying illustration. It will be noted that the chain used in this unit is not a friction member but one that positively grips the wheels by means of packs of laminations which engage radial grooves in the wheels. This positive driving action is the distinguishing characteristic of the P.I.V. Gear.

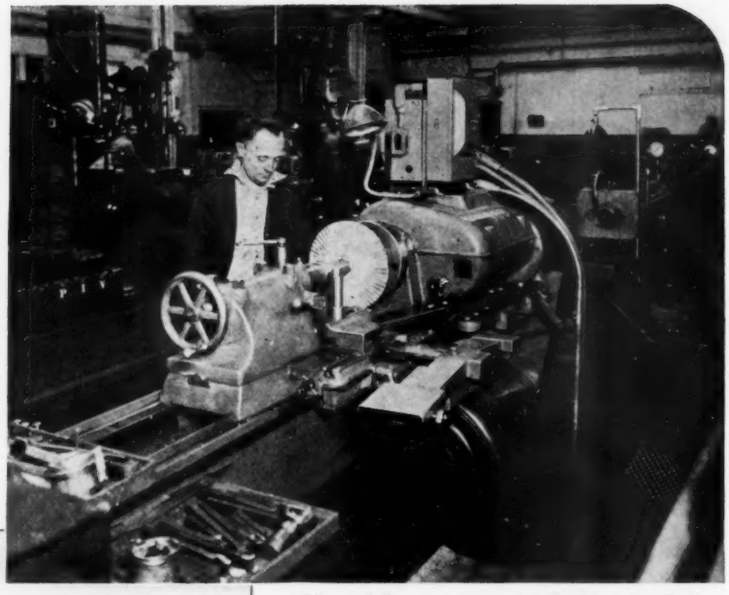
Without going into all the refinements of design, one unusual feature should be noted. As the cones move in and the chain belt moves out toward the periphery, the angle of wrap increases. Were no correction made, this increase would cause a tightness of the belt at extreme positions as compared to the center position. This variation is sometimes taken care of by a compensating toggle in the arm that actuates the cones, but in the P.I.V. drive it is done instead by a slight curvature of the conical faces. This is only one of many details that raise a nice problem in the manufacture of these units.

In the United States and Canada, rights to the P.I.V. drive are controlled by Link-Belt Company, and the

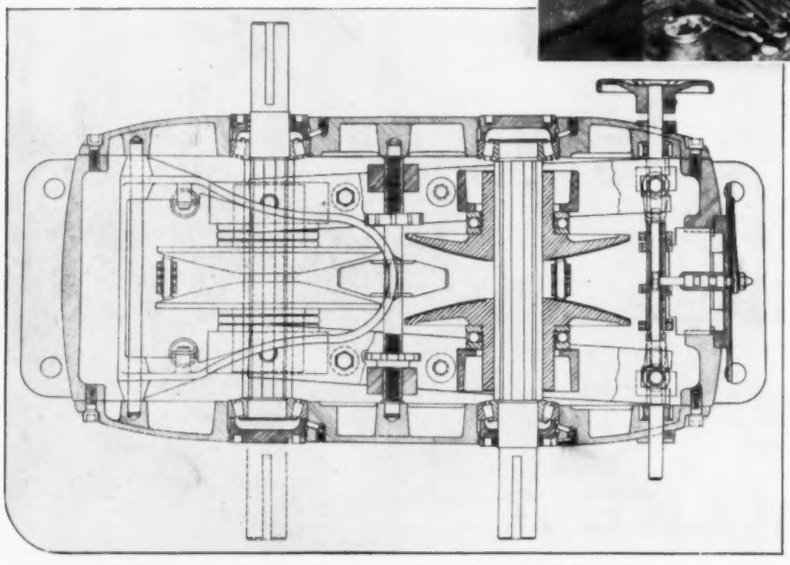
units are made at this concern's Philadelphia plant. Because of the increased demand for these transmissions, a completely new department was recently set up for their manufacture.

A section of the plant was cleaned out completely, and the P.I.V. department started from scratch. The management thus had an opportunity to plan the layout in accordance with its best judgment without compromising with older arrangements of equipment.

Complete rearrangement such as this is rather unusual; ordinarily new departments just grow, with continued consideration for existing conditions. It is the purpose of this article to show how this revamping was done



Adapted for use on a standard engine lathe this radius turning attachment is used for the finish cut on six sizes of wheel faces



One pair of wheel faces is forced inward and the other outward by two link bars actuated by a double-threaded shaft

and some of the results achieved.

The manufacture of the P.I.V. Gear may be divided roughly into three major groups:

1. **Machining**
2. **Heat-treament**
3. **Assembly**

These three groups are closely interrelated; the department's layout, for example, which will be discussed in connection with the assembly operations, is also an important consideration in machining and heat-treating. The division is made only for convenience in discussing the over-all result.

Of the machining operations probably the most interesting are those on the conical wheel faces; these are made of molybdenum steel (SAE 4615) in the three smaller sizes and of Nitralloy in the three larger sizes. In general, they resemble steep-faced bevel gears integral with a bearing sleeve.

The sequence of operations is as follows:

1. No. 2 Warner & Swasey turret lathe. Wheel faces are rough bored with the forgings chucked by the flange; the hub is rough turned, removing about $\frac{1}{8}$ in. of metal.

2. Gisholt turret lathe. With the forgings held in the hydraulic chuck by the hub, the outside diameter and the face of the flange are rough turned.

3. Wheel faces for Nos. 0, 1 and 2 units are normalized (SAE 4615 forgings).

4. Lapointe machine. Spline in bore is broached.

5 and 6. Lodge & Shipley engine lathe. Finish turned all over.

7. Cincinnati hydromatic milling machines. Teeth are cut in wheel faces.

8. Harden. Parts for Nos. 0, 1 and 2 units are carburized and hardened; those for Nos. 3, 4 and 5 are nitrided.

9. Lapointe machine. Rebroach.

10. Cincinnati grinder. Grind hub of wheel faces in Nos. 0, 1 and 2 sizes only.

11. Test and check all parts on a special testing machine.

In the first operation, two interesting combination tools are used in the turret. One of these drills the bore and turns and faces the hub. The second tool faces the back of the flange and puts in the undercut at the base of the flange. Both these tools are adjustable for the different sizes of work. The bore is then roughed and finished in two other turret stations.

A Logan hydraulic chuck holds the piece in the second machine. A form tool with special cutter blades for each size of blank roughs out the wheel face

while a tool in the cross-slide turns the outside diameter.

After broaching, the wheels are held on a splined arbor for finish turning. This is done in two steps—one of which is to finish the curved wheel faces and the other is to turn and face the other portions.

For the curved wheel faces a special radius attachment is used, consisting of a rigid bar pivoted to the bed at the back of the head and to the cross-slide of the lathe. Six holes in the bar enable it to be used on the six sizes of wheel faces.

The center of the radius on the wheel face does not coincide with the center line of the piece but is offset on the opposite side of the center line. For example, No. 1 size has a radius of about 19 in. and an offset of about 3 in., while No. 5, the largest size, has a radius of about 42 in. and an offset of about 7 in.

To obtain this offset the radius bar is placed parallel to the bed and a half arbor is held between the centers. Then the cross-slide is run against a pin held in the radius bar while the tool is set to the arbor. Notches in the back of the cross-slide, which are numbered with the part to be turned, are offset the correct distance from the pivot position so that when the bar is swung into a recess in the slide and the pivot pin inserted, the center of the radius will have its correct position relative to the tool point.

By far the most unusual machining operation on the entire P.I.V. Gear unit is that for machining the grooves in the wheel faces. Consider that these grooves are cut to a constant depth but are tapered sidewise with their faces converging to a common center; add to this the complication that the wheel face is not a true cone but a conical surface modified by a radius, and the task of machining is made still more difficult. Yet this work is being performed in a single operation at the Link-Belt plant and by two entirely different methods. Both methods give accuracy to 0.002 in.

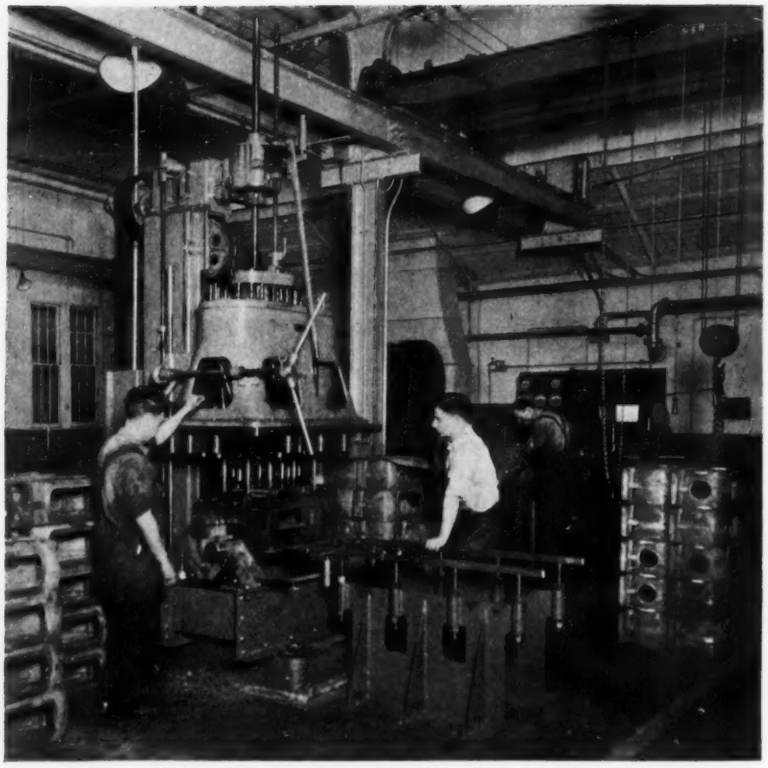
The method which has been in use the longer and which is used on the larger sizes consists of an adaptation of a Cincinnati Hydromatic milling machine. A special holding device holds the work at such an angle that it is fed into the cutter large diameter first. The fixture supporting it is driven through a crank mechanism which reciprocates it rapidly about the apex of the modified cone. The amount of the motion is such that a cut is taken the full decreasing width of the groove.

The cutter is of special form, consisting of a flat milling surface with a small tit projecting upward at the center of each tooth. The sides of these projections are beveled to the angle of the sides of the grooves. The width is slightly smaller than the width of the grooves at the small end.

As the work is fed into the cutter, its angular reciprocation stays constant, but since the motion is about

Grooves in the carburized and hardened wheel faces are finally finished in a milling machine that has been adapted for grinding

Either milling or shaping is used to cut the tapered grooves with a slight radius in the P.I.V. wheel faces



Multiple drilling on four sides of the housings is aided by a turnover fixture with a locating pin

the cone's apex, the movement at the cutting edge becomes smaller, giving the correct radial direction to the side walls of the grooves. At the same time the flat faces of the cutter teeth take a light cut on the tops of the lands, thus taking all surfaces in one pass.

The mechanism so far described takes care of everything but the curvature which modifies the conical face and which the grooves must follow to maintain their constant depth. To bring this about, one end of the milling fixture is pivoted horizontally while the other follows a cam clamped to the side of the bed. The effect is to cause the leading end of the fixture to drop with the cam as the feed progresses, swinging the work downward to give the grooves the proper radius. The work is indexed automatically between grooves by a ratchet mechanism on the periphery of the work holder. A different cam is needed for each size of wheel.

The other method of grooving, which is used on the smaller sizes of gear face, is accomplished by the use of a special shaping machine. Here again the work is held on a tilted holding device. It is indexed slightly between each stroke and then automatically to the next groove as each is completed. The table progresses slightly as the work holder revolves, causing a rolling action between work and tool.

A link connects the vertical adjusting screw of the toolhead with a pivot pin mounted on the machine frame. As the shaper ram reciprocates the motion of this link causes the vertical screw to rock, moving the head up and down a short distance during the stroke and causing the tool to cut the grooves on a radius. In addition, the tool is automatically lifted for clearance on the back stroke.

Since the three larger sizes of gear faces are nitrided, the comparatively low temperature used does not impair their accuracy. The smaller sizes, which are carburized and hardened, are subject to some distortion. A correction is made by grinding the grooves after heat-treatment in a Brown & Sharpe milling machine that has been reconstructed for this purpose. A formed wheel, with an angle corresponding to the sides of the grooves, takes a cut from both sides and bottom.

The work is held and reciprocated in much the same way as was done when milling the grooves. The chief difference in this set-up is that in order to form the radius the wheel rather than the worktable is made to follow a curved cam. Indexing is done by hand on this machine.

Grinding of the hub of the wheel face completes the machining. The parts are then inspected in special testing fixtures which checks the accuracy of the grooves by the use of Starrett dial indicators.

While the wheel faces depart from ordinary machining methods more than other members of the P.I.V. Gear units, the same ingenuity and care is exercised in the other operations. For example, holes in the main housing of the unit are drilled in a roll-over fixture using a Natco multi-spindle machine. First, two opposite sides are drilled for the cover plates; then the two intermediate sides are drilled, using a different arrangement of drill spindles. In each position the work fixture is locked in place by a heavy stop pin.

This procedure is typical of the care exercised in building accuracy into the P.I.V. Gear. Such methods are reflected in ease of assembly and smoothness in operation.

Part II on heat-treament of the P.I.V. Gear will appear in an early number.

Tolerances

C. G. WILLIAMS

There are wide differences of opinion as to what tolerance really is. In a railroad this means $\frac{1}{8}$, or less, and that brings to mind a little scene.

A callboy had been promoted to shop office boy, to blueprint boy and in the course of time to draftsman. He came into the shop one day and asked what tolerance to use on the drawing of a certain part of a locomotive.

"None, by jingo," said the G.F. "Put down just what she is." Probably that G.F. never knew what tolerance meant. Even some engineers get mixed up on the term.

How Would You File Large Rolled Tracings?

The chief engineer of a company manufacturing machinery and tools has between 150 and 200 large rolled tracings. These are kept in drawers in groups of about 25 so that when one is needed, it is necessary to "paw" over the whole 25 of them. None of these tracings is over 36 in. wide. He asks for suggestions on how to file these tracings which are evidently so long that they cannot be laid flat in a drawer.

EARLY DAYS on *A.M.*

FRED H. COLVIN
Editor

In his second reminiscing article Mr. Colvin recalls the men with whom he worked when he first joined the staff, and tells of the things for which they fought

I WELL remember the old *American Machinist* office at 96 Fulton Street, which at the time of my first visit also housed the new paper, *The Locomotive Engineer,* of which John A. Hill was the first editor. The whole office was crowded and John was in a small inclosure that held little more than his roll top desk. It was here I first met Frank F. Hemenway, editor, and Fred J. Miller, associate editor, likewise Professor Myers, whose series of articles on locomotive construction and design and on mechanical drawing were notable contributions to mechanical literature at that period. They also show to what extent specialization has become necessary in technical journals. The *American Machinist* at that time dealt as much with steam engines, locomotives, foundry and woodworking machinery as with machine production, which is of course impossible at present, even if it were desirable. It was Frank Hemenway's experience with steam engines that first brought him to the *American Machinist.*

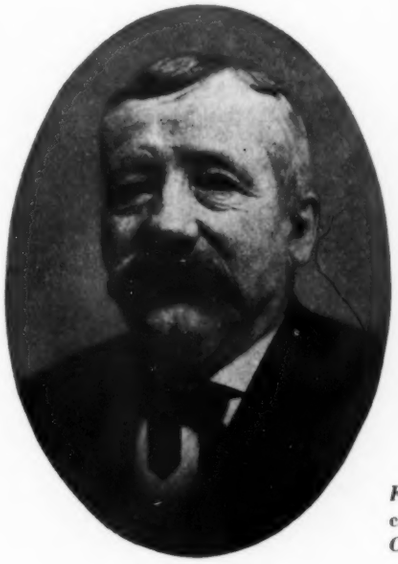
Frank Hemenway was one of the best hearted men I have ever known. He was kindly and considerate of every one but himself, and I feel that I owe him much both because of his kindly advice to a young writer, and because it was through him that I became the first editor of *Machinery,* which for three years gave me an opportunity to find myself and to get a foothold in this field. Frank's desk, however, was the standing joke of the office, and of his friends. It was always cluttered with papers except for a small space near the center which gave him room to write. Frank wore eyeglasses, and lost them in his desk with great regularity. They would slide under some of the papers and disappear. After a short hunt he would go out and buy another pair, and in the rare intervals when his desk was cleaned he would unearth enough eye glasses to keep him going for some time.

Fred J. Miller came to *American Machinist* in October, 1887, from Warder, Bushnell & Glessner, Springfield, Ohio, where CHARLES BAUER was the manager. Bauer was quite prominent in the A.S.M.E. during the early years of my membership and was always proud of having had Fred Miller in his shop. My first intimate contact with Fred was in Chicago at the World's Fair in 1893; he was stationed there at the time of my visit. His familiarity with the exhibition made it easy for me to see the high spots in our line, although at that time I was with the old Wheelock Engine Company of Worcester, Mass. But the methods of machining metal parts were always a main objective, and Fred was of great assistance in this.

Later I came to know Frederick A. Halsey, Frank Richards, E. A. Suverkrop and Frank Stanley. Of this group only Stanley is now living.

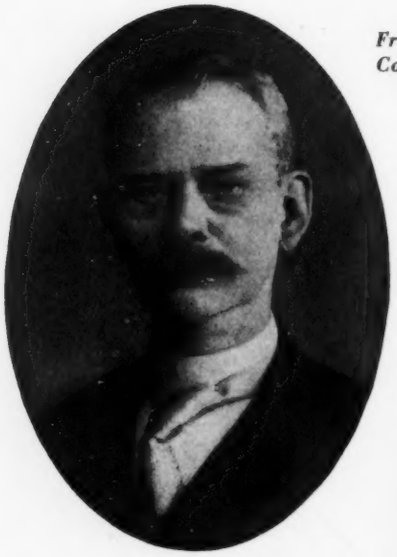
Frederick A. Halsey was widely known for his premium plan and for his violent opposition to the compulsory adoption of the metric system in this country. He was also the author of several books, well known in their day, but the two achievements named stand out in the minds of most. Of a very intense disposition he was a strong partisan in whatever question was under discussion. He was in charge of the *American Machinist* when I first became a member of its regular staff and I have only the pleasantest recollection of our work together.

Frank Richards was a lovable man, many years my senior, but kindly in every way. Frank was quite a philosopher and wrote much on subjects that were not strictly mechanical, under the name of Tecumseh Swift. He was responsible for the Question & Answer columns in the *American Machinist* for many years, giving many hours of patient research to find the right answer to all sorts of questions.



F. F. Hemenway, editor of American Machinist *at the time Mr. Colvin started writing for it*

Fred J. Miller, editor from 1894 to 1907



Frederick A. Halsey, editor when Mr. Colvin joined the staff in 1907

John A. Hill, principal owner of American Machinist *from 1897 to 1916*

Ed Suverkrop, always known as "Suver," was an unusual character. Quick witted, he was keen at repartee, which frequently left a sting. Of wide experience both in this country and abroad, he was a clever mechanic and a licensed steamship engineer. He had a fund of yarns from all over the world and made friends easily. Especially interested in fine measurement he made a hobby of gage blocks and developed a method for producing them. Oddly enough, he also made arrow heads that would do credit to an Indian.

John Hill's connection with American Machinist Company arose from a suggestion my father made to president Horace Miller when he was looking for an editor for his new paper for railroad men. John had written considerably for the *American Machinist* and his writings appealed to my father's sense of fitness of railroad shop work, for father had been a locomotive engineer on the Lackawanna in Civil War days. As a result of this, John was a frequent visitor to our house, and we were close friends until his untimely death.

About the same time I became acquainted with Fred Low, who was even then editor of *Power* and a national figure in steam engine lines. This acquaintance ripened into a real friendship with the years that passed, for we became members of the same organization and his activities in the A.S.M.E., of which he became president in 1924-5, also brought us into close contact. He was a grand person and a loyal friend.

During the 50 years I have known *American Machinist*, it has made many notable contributions to the advancement of the machining of metal. One of the early attempts at the measurement of power used by cutting tools was that of James F. Hobart, a special correspondent of the *American Machinist* who first visited our shop in about 1885. He probably bears more responsibility than anyone else for the many articles I have written. It was he who urged me to send in my first contribution which appeared on April 3, 1886.

Hobart had a sort of power measuring countershaft, as I recall it, that he proposed using on my old 16-in. lathe. This lathe, incidentally, was still in use the last time I visited the old shop a few years ago. He finally made his tests in another shop because their conditions seemed to afford a wider scope than was to be found with my lathe. Of all the wandering millwrights, for Hobart was primarily a millwright of ability, he is the star example. From Massachusetts to Missouri, and from Minnesota to Florida, there are few localities in which he had not worked. This work led others to experiment on cutting tools, but none so thoroughly as Fred Taylor was to do later.

The foundry played an important part in the early *American Machinist* issues and W. J. Keep, who was a most capable and interesting man to meet, wrote considerably regarding his tests and experiments with irons of density and strength. He was the first man I called on when I went to Detroit on my initial visit. Thomas D. West was another foundryman whose ideas were set forth in the *American Machinist*.

Cutting Compound Rackets

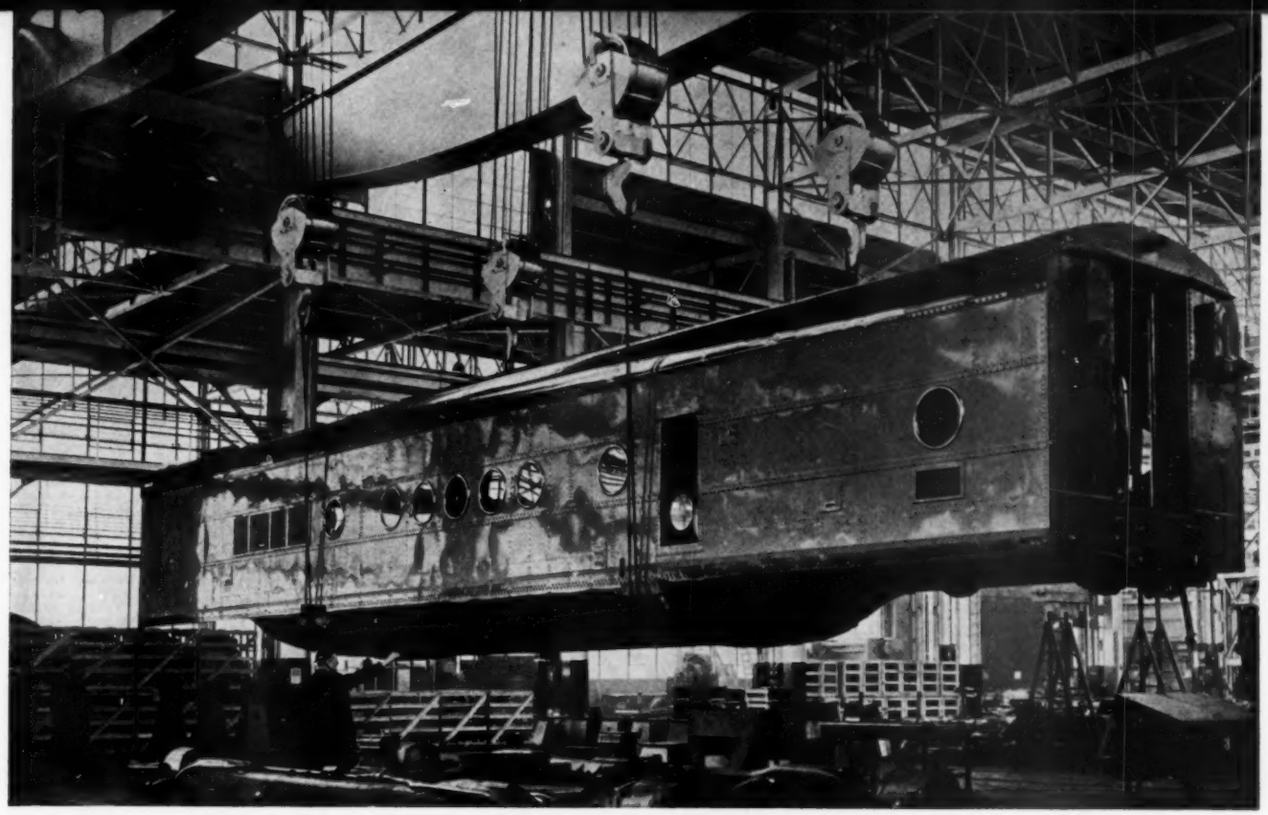
Few now remember the vigorous campaign against the Fink cutting compound formula, which was rather widely sold and was practically worthless. This finally ended in a law suit, as I recall it, where *American Machinist* was sustained. Years afterward I ran across a revival of this racket in El Paso, Texas. Fortunately, the master mechanic had been a reader of the *American Machinist* for years, and nailed the racket when it was attempted in his shop.

Safety campaigns, which accompanied the compensation activities of 25 years ago, were vigorously supported in *American Machinist*. Few of the younger men realize that these laws, or customs, are of such recent date.

Modern methods of all kinds have been shown and advocated as a matter of course. This includes the growth of milling, of grinding, the changes in gear cutting, welding, broaching, honing, use of conveyors and all the rest. The paper has also endeavored to discourage the use of the newer methods and appliances in fields where they were of doubtful value, or at least where their value was yet to be proved. Panaceas that cure all shop problems are still extremely scarce.

Industrial Workers Get Degrees

Early entry into industrial occupations need not be a bar to higher education and academic distinction according to a plan adopted by Cadbury Brothers, of Bournville, England, and described in *Industrial Britain*. This company, which has been a pioneer in welfare work, has made a practice for the past few years of awarding scholarships and giving assistance in various ways to employees who wish to continue their education. During this time 27 industrial workers have graduated at one or the other country's leading universities. They have taken mostly science or commercial degrees. At the present time several employees are studying at Cambridge, London and Birmingham universities.



A 200-ton all-welded crane handles huge locomotives like toys

WHERE DIESELS ARE RAILROADED

BURNHAM FINNEY
Western Editor

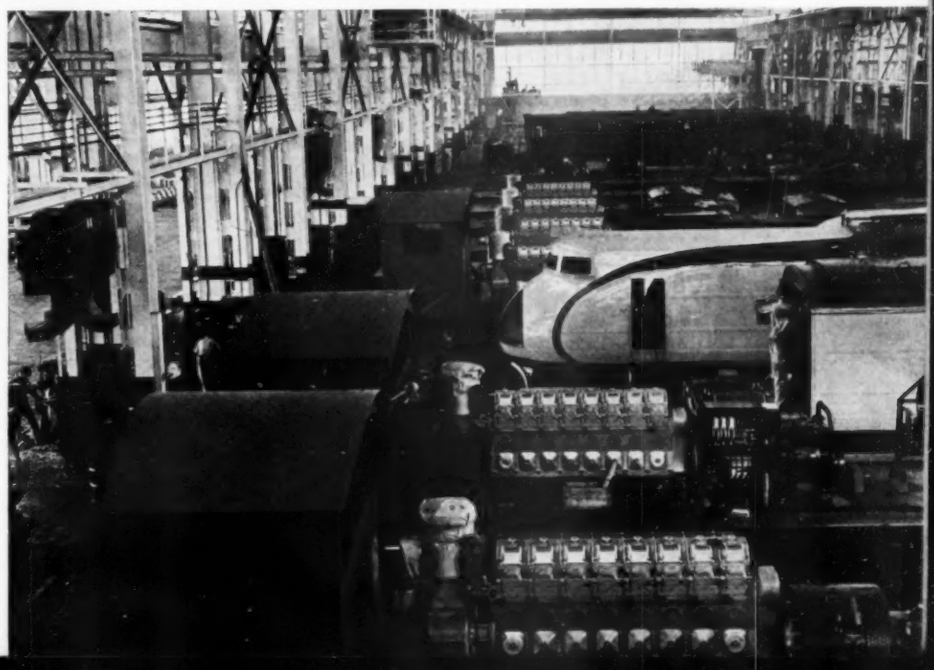
After five sites were tested and rejected, La Grange, Ill., was chosen as home of the Electro-Motive Corporation, the world's first complete diesel locomotive works

THE Burlington Zephyrs, the Union Pacific's "City of Portland" and the Boston & Maine's "Flying Yankee," flashing across the horizon at 100 miles per hour, are visual evidence of a new day in railroad transportation. Changed economic conditions and increasing severity of competition have put the country's railroads in a position where of necessity they are hastening to adapt themselves to the new order. Among other things, they are turning to new forms of motive power, such as diesel locomotives, in an effort to secure speedy, efficient service at relatively low cost.

Observing this trend, Electro-Motive Corporation, a division of General Motors, has recently built and now has in full operation a new plant at LaGrange, Ill., fifteen miles out of Chicago, for the manufacture of diesel locomotives. The result is a plant as modern as the products which it builds.

As nearly as possible with a product so bulky as locomotives, progressive assembly line manufacture is used, with subassemblies feeding it. Equipment and plant layout have been chosen with an eye to bringing the tools to the job rather than taking the job to the tools. Wherever possible, machines are portable; some of the machine tools

The large erecting shop has 24 construction bays in its main aisle



stand on heavy steel plates on the floor so that they can be picked up by crane and moved from one job to another.

Carrying this idea a step farther, the management has devised a system for placing small parts and working tools alongside the job so that they are at the workman's elbow. Large wooden boxes painted green are filled in the materials warehouse and the tool storeroom with all the paraphernalia necessary for a given job and are taken directly to the production spot by electric truck. One box contains electrical parts, another miscellaneous parts and the third tools.

Scarcely anywhere else will one find as wide use of welding as in the Electro-Motive plant. As weight becomes an increasing factor in construction of passenger locomotives, application of high tensile alloy steels looms as an outstanding feature. Arc welding is used to great advantage, providing maximum strength and thus allowing more power to be installed in a locomotive of given weight. This in turn results in rapid acceleration, a desirable item in the economical operation of high-speed trains.

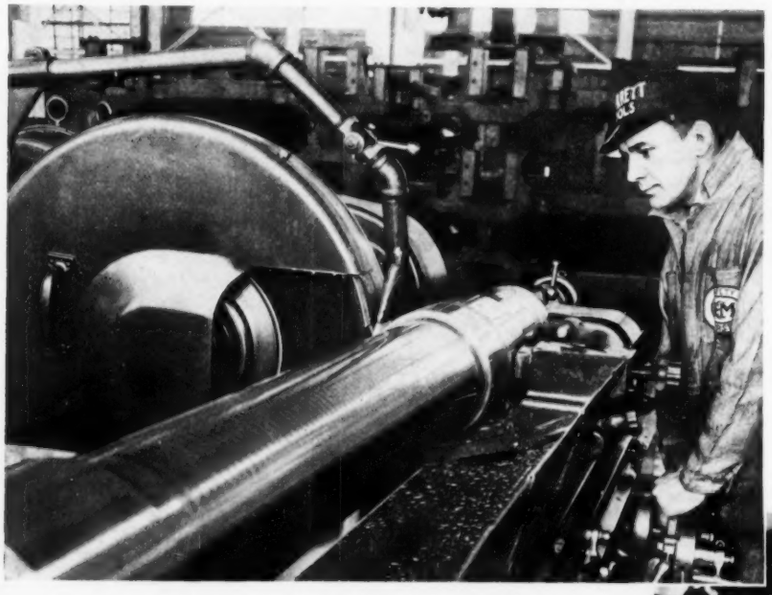
The plant itself consists of nine buildings constructed of electrically-welded structural steel. Fifty thousand feet of welding rods and 7½ tons of electrodes were required to erect more than 2,000 tons of structural members.

All cranes are of all-welded construction, the largest being a 100-ft. span, 200-ton double-trolley electric traveling crane weighing 205 tons. Equipped with four 50-ton hooks, this crane has a one-piece welded trolley frame and one-piece welded end trucks, with welded box girders and bearings of the MCB type. All gears and pinions are inclosed in welded oil-tight cases which remain oil-tight without the use of packing. All conductors are of angle iron; Hyatt roller bearings are employed throughout.

Welding facilities are ample to meet every need in production processes which utilize welding to the exclusion of almost all other methods. Several of the bays, for example, have special cast iron bed plates machined and slotted to serve as a foundation for precision welding operations. Individual transformers have been installed on alternate columns the entire length of the main isle of the plant to provide current distribution. These transformers, at 48-ft. intervals, have three-phase, 440-volt feeders carrying current to lighting transformers which convert the power into single-phase 220 volts, with 110 volts secondary. It thus has been possible to avoid installation of three or four sub-stations through the building, each with its own oil-cooled transformers.

Oxy-acetylene for cutting is used extensively throughout the plant. The oxy-acetylene equipment is housed in a separate building, just outside the main structure, and the gas is piped to all parts of the factory. There also is an elaborate piping system to provide compressed air at all necessary points. At alternate columns along the main bay, alongside each other, are outlets for electric power, acetylene gas and compressed air.

The largest building, housing the erection shop and machine shops, is 550 ft. long and 170 ft. wide. The main erection aisle has a span of 104 ft., with clearance of 49 ft. under the roof trusses. Extending over 500 ft., it consists of 24 locomotive construction bays, most of which are served by tracks laid transversely in the aisle. In-



Fine finish on an axle reflects the care with which both large and small parts are machined

Torch cutting and both gas and electric welding have so important a place that special provision is made for them

dividual bays have been designed for specific steps in locomotive construction and are closely related to adjacent facilities for heat-treating, sand blasting and painting. These operations are housed in individual structures which open directly into the main erection aisle on the east. The tracks in these bays connect with a service and test track outside the plant.

Paralleling the erection shop on the west and opening into it is the machine shop, where all major locomotive parts are machined. Small precision parts and instrument panels are finished on a balcony at the south end of the main isle. A well equipped toolroom is located at the head of the machine shop aisle.

After the bottom and underframe of locomotives are arc welded together, the frame is normalized in a track-type annealing furnace, a flat car surfaced with firebrick serving as the furnace floor. The interior of the furnace is 74 ft. long, 13 ft. wide and 9 ft. high. It is gas-fired; at each side, flues extend from the top to the bottom, resulting in an even temperature throughout the furnace. The temperature is controlled automatically by pyrometers and potentiometers. In the same auxiliary building as the annealing furnace is a blacksmith shop containing a small furnace employed for normalizing or for heating small steel parts to be forged.

Scale and other foreign matters are removed from locomotive plate steel by means of steel grit instead of sand. The work is placed over a metal grating and the grit sprayed on the steel under high pressure. The grit falls through the grating onto a belt conveyor and is recovered, the dust being separated from it and discharged out of the building by an exhaust fan.

Locomotive hoods are sprayed with lacquer in a building which can be partitioned off into four separate, glass-inclosed rooms in each of which one hood can be painted at a time. Hand-operated sprays are used; exhaust fans slightly above the floor level suck out the fumes, discharging them outside the building.

Safe operation as well as future progress of diesel locomotives depend to a large extent on the metallurgical properties of the metals used in their construction. For this reason the Electro-Motive management has established a metallurgical department with ample facilities for highly specialized laboratory or shop tests which are needed by the erection shop or the engineering division.

Chemical and metallurgical control guard against inferior material and aid design

Included in the physical laboratory equipment is a 50,000-lb. universal testing machine which is used for routine tests of metals

This department has five principal functions:

(1) To maintain rigid physical, chemical, and metallographic control of all important metallic parts entering into construction of high-speed diesel locomotives; (2) to record the characteristics, manufacturing procedures and performance data of important parts of locomotives fabricated or finished by the shop. This includes complete information on wheels, axles, under-frames and welding technique; (3) to develop metallurgical processes involving new materials or improved methods of thermal or physical treatments. Such work may be carried out independently by the department or by cooperation with other manufacturers; (4) to accumulate data on metals, fuels and lubricants on which to base recommendations for future materials specifications for various parts of locomotives and for their economical service; and (5) to seek and disseminate fundamental knowledge of engineering materials used in modern high-speed transportation.

Little differentiation is made between strictly

laboratory and shop tests. All equipment in the department must conform to any or all of the purposes outlined. The analytical laboratory, for example, comprises a section for accurate determination of all technically important elements in ferrous and nonferrous matter. Apparatus for detecting certain gases in welds is being installed.

Another part of the laboratory is devoted to measuring properties of fuel and lubricating oils used in operating diesel locomotives. Although A.S.T.M. standards predominate, the laboratory has broadened the scope of certain tests to cover characteristics beyond standardized limits. Viscosity tests, for instance, are made to cover the entire temperature range of service conditions rather than to measure Saybolt seconds only at 100 and 210 deg. F. The complete viscosity - temperature diagram has a greater value to railroad operators than an index of viscosity at one or even two temperatures. In addition to the standard Saybolt universal apparatus, the newly-developed viscosimeter of Steiner is available for tests.

A Leitz metallurgical microscope and a permanent photographic camera with either arc or photoflood illumination are utilized for microscopic and macroscopic studies. An electro-graphical etching method, utilizing an electrolytic paper, is being developed to record the macrostructures of welds. All thermal treatments are conducted in pyrometrically-controlled electric furnaces.

In the mechanical section of the laboratory is a universal tensile testing machine with a capacity of 50,000 lb. suitable for specimens up to 8 ft. long. Hardness tests may be made by the conventional methods of Brinell, Vickers, Rockwell and Shore. A special machine for measuring impact hardness at elevated temperatures is used to investigate metals subjected to engine heat or to mechanical friction.

Mechanical handling in the main erection bay and the machine shop bay has been designed for a maximum of flexibility and avoidance of delay. The 200-ton crane is the largest unit of its kind ever welded. Its girders alone, fabricated from plates $\frac{7}{16}$ in. to $1\frac{1}{8}$ in. in thickness, weigh 80,000 lb. each and required three flat cars to take care of their length in shipment. The trolleys were so heavy and cumbersome that they were shipped in cars with specially constructed wells to negotiate railroad clearances.

Two auxiliary electric traveling cranes of 30 and 40 tons capacity supplement handling facilities in the main aisle and the balcony machine shop. These cranes, as well as the 200-ton crane, are equipped with hydraulic bridge brakes and Clark face-plate type controllers, with anti-friction motors set up for 550 volts of direct current. Power is provided by Winton diesel generator units on test at the plant.

This aisle also is served by a 15-ton gantry crane which passes transversely through the plant at the north end on rails in a double bay 48 ft. wide. The track extends 200 ft. along an unloading area outside the plant to bring heavy materials into the shop. Two 20-ton traveling cranes take care of machine shop handling requirements.

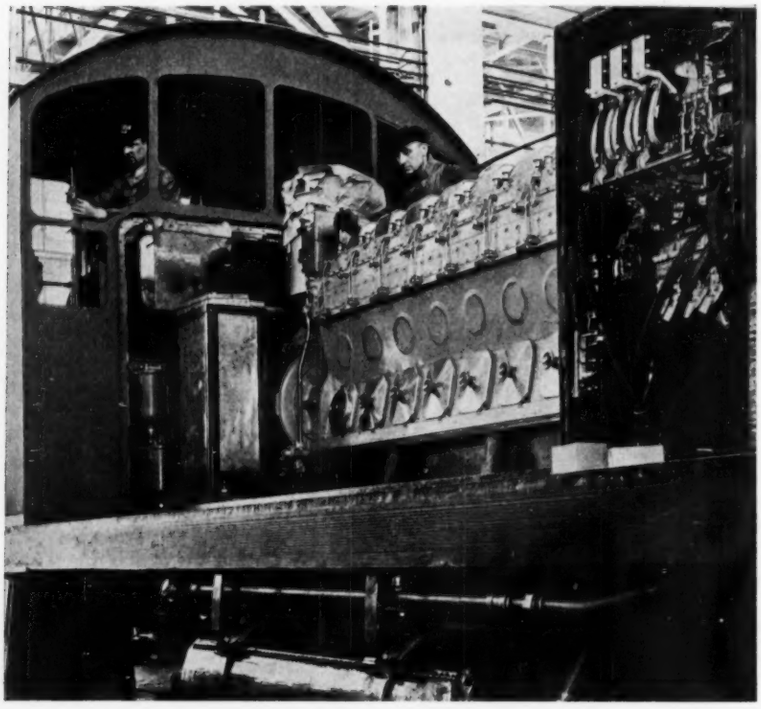
Power generated by the Winton diesel engines is adequate to meet all the plant's needs, but it is used only for the cranes and some of the machine tools which operate on direct current, such as wheel-turning lathes and variable-speed toods. A 550-volt synchronous motor generator set is employed to load the diesel engines; in case of a breakdown, this generator set can supply power to the shop. Because of the necessity for changing engines on test at frequent intervals, the test room has a removable roof and is served by the two cranes in the machine shop aisle. Adjoining the engine test room is a locomotive testing pit; the power generated there also can be converted into constructive use in the plant.

The company can operate without aid from any public service agency, since it has its own power plant, water system, sewage disposal plant, fire protection apparatus and heating plant. A 1600-ft. well, drilled through a 300-ft. bed of solid limestone on which the plant rests, furnishes water at the rate of 310 gal. per min. to a 200,000-gal. reservoir. Sewage from the plant runs by gravity into an octagonal basin inside the base of the power house stack.

Measured illumination has been provided throughout the plant by direct lighting. Aluminum reflectors with special non-corrosive finish assure undiminished brightness without excessive maintenance cost. These reflectors carry 1000-watt lamps on the roof trusses 49 ft. above the working floor in the main aisle. They are arranged so that traveling cranes cannot interfere with the light from more than one outlet at one time.

Transverse monitors give permanent lighting and ventilation in the machine shop, the largest sections of horizontal sash ever erected closing in its 550-ft. west wall with one broad sweep of glass which will be removed when contemplated expansion is carried forward.

The plant was built by the Austin Company. The layout is such as to accommodate shops four times the present size without increasing service facilities.



Measured lighting throughout the plant contributes to high grade workmanship in machining and erecting

Talking Shop

The Splinter Fleet

Under this title Ray Milholland of the old Indianapolis machine tool building family has written an account of the doings of the subchasers in the Mediterranean during the World War. Such a book is hardly eligible for a formal book review in *American Machinist* but it is such a good yarn and

smacks so much of the shop that it should appeal strongly to readers of this paper. Mr. Milholland was chief engineer of three of the 110-ft. chasers, and therefore speaks with authority of the hardships on those craft in dirty weather, and of the ingenious repairs that had to be made at sea. His references to finding new American machine tools in the Austrian naval base at Cattaro have a grim humor. Also his comments on the lack of respect with which "iron navy" and chaser men regarded each other. Bobbs-Merrill, Indianapolis, publish the book.

Are there bad order cars in freight service on the railroads? Let a machine tool builder tell his experience. Several recent shipments of expensive machines arrived in bad order because water had splashed up through the honeycombed floor and got into the crate which had not been waterproofed on the bottom. Now this shipper lines the bottoms of his crates and puts several sheets of tar paper on the floor of the freight car before the crate goes in.

Centrifugal Castings

Centrifugal castings are not as new as many imagine. Thomas Lovegrove of Baltimore took out patents in 1848. But, as has happened so often, while he had the idea he lacked the ability to make a practical application. Other patents were granted in England and Germany in the 1860's, and still more in 1873 and through the 1910 decade. Now the method is being used for both ferrous and non-ferrous metals, with marked success.

Scientists long have known that the sea contains lots of things besides fish; they have long dreamed of abstracting from it most everything from power to gold. Most of these schemes have hit an economic bump when the question of cost came up. But the Ethyl-Dow Chemical Company is already getting bromine for anti-knock gas from the waves off the coast of South Carolina; and Mr. Henry Chesny, of Marine Chemicals Company, Ltd., told the American Chemical Society that "the ultimate source of magnesium compounds for large scale consumption will be their production from sea water."

Stagger the Load

Avoiding peak loads can save a lot of dollars on the power bill. One railroad shop official recently told of saving about $350 per month by stagger-

ing work between his machine and woodworking shops. The machine shop quits work at 4 p.m. and the wood shop starts at the same time. Woodworking machines take a lot of power, and the two shops together made a high peak load. This plan may have application in other industries.

"Swing it" may be the keynote for industry as well as for Harlem jazz. According to F. W. Shumard, dean of the National School of Time Study, laborers who sing or chant during their work feel less fatigue at the end of the day. The rhythm they create for their movements makes their work easier and keeps their minds off the contemplation of tiredness.

Welded Ships

Welding is slowly being recognized as a standard, reliable method of joining metal parts. An excellent example is that of the first all-welded ship of record, the *Fullagar*, launched in England in 1920. Lloyd's still gives it an A1 rating.

Rust Proofing

Rust proofing is being recognized as an advantage if not a necessity in many kinds of machines. Formerly confined to small parts such as screws it is finding its way into the construction of large machines, including machine tools.

While employment in all U. S. manufacturing industries stands at 84 per cent of 1929, employment in this country's ten newest and most highly mechanized industries is 94 per cent of the 1929 figure, according to a study made by the National Machine Tool Builders' Association. This additional bit of evidence again exposes the fallacy of the belief that machines create unemployment.

Dark Shops

We'd like to take one of these illuminating engineers with his gadget for gaging light intensity through one of the shops we've seen lately. It was an old building of the vintage when they spaced windows a long ways

apart, and they hadn't been washed since the Spanish-American war. It's a safe bet that the aforesaid illuminating engineer would need a flashlight to make sure the needle hadn't sheared off the stop pin at the lower end of the scale. There's a lot of work to be done all over the country on better lighting. Makers of lighting equipment should be kept busy for the next ten years just catching up. —*The Editors.*

TUBING CUT OFF in the PRESS

C. W. HINMAN

Two blades are arranged to shear a $\frac{1}{64}$-in. wall without distortion and without burrs

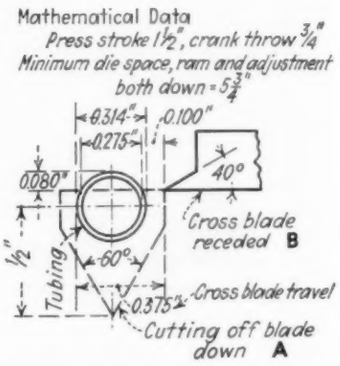
CUTTING off thin-walled metal tubing without using an inner support and without leaving perceptible shearing burrs was a problem we had to meet recently. We soon determined that this operation must be an "inside" job because no kind of cutting-off blade, no matter how cleverly designed, could be made to shear through light-walled tubing from the outside without distorting it.

Aluminum tubing in 10- and 12-ft. lengths, having an outer diameter of $\frac{7}{16}$ in. and a wall thickness of $\frac{1}{64}$ in., was to be cut into lengths of from 3 to 6 in. without distortion and without perceptible inside or outside burrs.

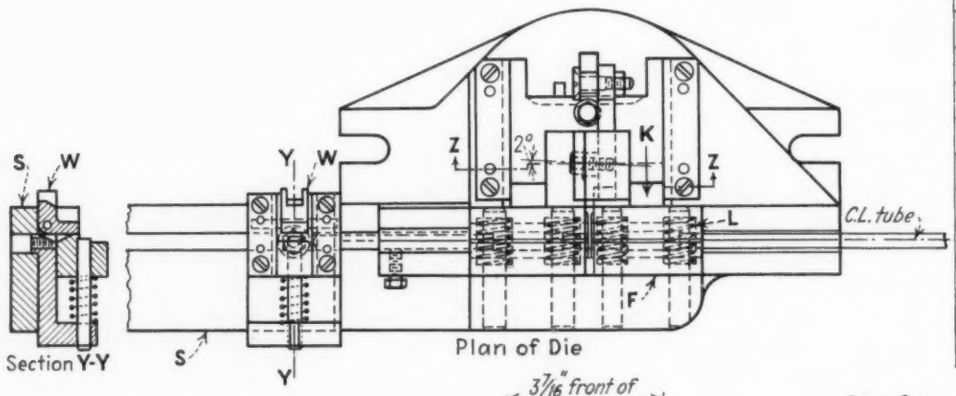
The tools for this operation are shown in the upper right-hand corner of the illustration, together with a table giving the tool conditions and the cutter positions occurring at different degrees of the crank throw, which correspond with levels of the ram descent. The cutting-off blade *A* and the cross-blade *B* are each 0.040 in. thick and have shoulder guides between the vises, as shown in the main drawing.

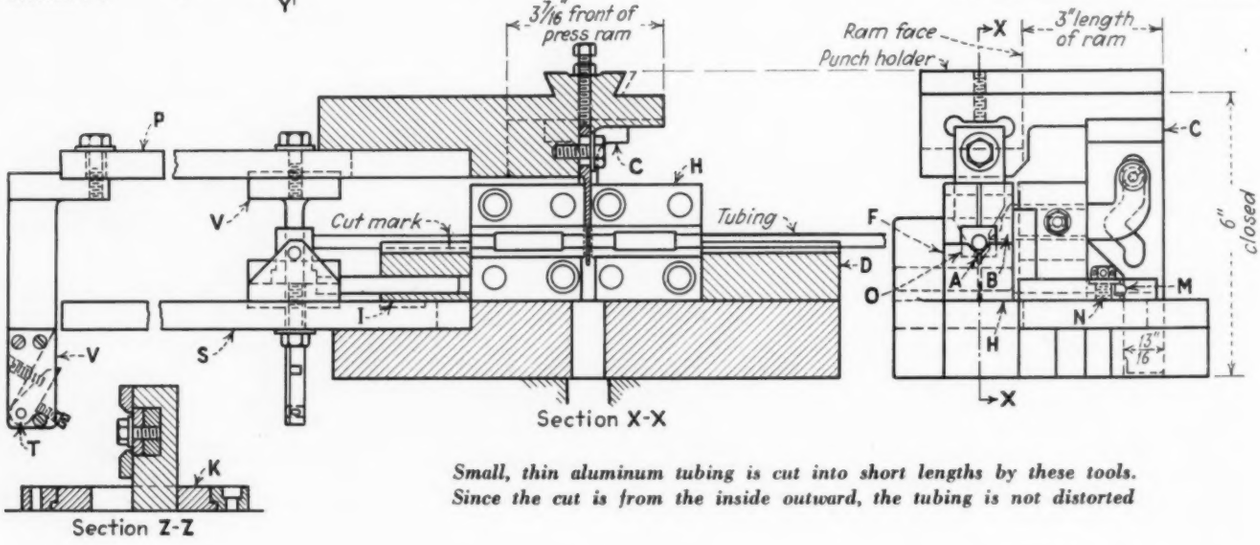
The 40-deg. angular-edged cross-blade makes the first cut. Its angular nose curls the chip ahead of its path, opening a slot across the tubing to a depth equal to one-half the outside radius of the tubing. The moment its point cuts through the wall of the tubing, it shears the metal from inside the tubing outward.

When the cross-blade recedes, the cutting-off blade enters the opening made by it and descends through the tubing. This blade has an included angular shearing edge of 60 deg., which, in descent, curls the chip from



CRANK THROW DEGREES	RAM DESCENT	CONDITIONS
0°	None	Tube clamp is open
23½°	0.0625"	Tube clamps close
30°	0.100"	Cross blade starts cut
60°	0.375"	Cross blade finishes cut
90°	0.750"	Cross blade returns at rest
122°-45'	1.156"	Cutting off blade starts to cut
180°	1.500"	Cutt off blade starts return
330°	0.100"	Automatic stop starts to open
336½°	0.0625"	Tube clamps open
360°	None	Automatic stop closes





Small, thin aluminum tubing is cut into short lengths by these tools. Since the cut is from the inside outward, the tubing is not distorted

inside the tubing outward; a cutting action similar to that of the cross-blade. The slide carrying the cross-blade is reciprocated by means of an angular cam slot in the flat side of punch *C*. The cutting-off blade is attached to the punch holder, and both blades are adjustable by screws that pass through slots in them.

The tubing is fed from right to left and is guided by the V-block *D* into the half holes in vises *F* and *H*, being fed forward to a mark cut in the V-block *I*. This position is controlled by a finger stop, not shown.

The vises are closed on the tubing by the clamping action of the angular feed slide *K*, which is forced against the movable jaws by the front edge of punch *C*, in descent. The jaws are opened when the clamping angle recedes by the action of the four coiled springs *L*. Clamping adjustment is provided by moving the taper key *M*, which is locked by tightening screw *N*. The cutting blades are a sliding fit between the ends of the removable clamping blocks *O* attached within the vises. This condition prevents the forming of shearing burrs around the outside edges of the cut tubing. Adjustment is provided to compensate for the metal removed in grinding the clamp ends on each side of the cutters.

The automatic stop mechanism is mounted in slots cut in plates *P* and *S*, and can be secured in position for cutting pieces of any length within the capacity of the tools. The automatic stop is opened by the adjustable tripping pawl *T*, which is pivoted in punch *V*, when the ram ascends and when the clamps are released. The pawl punch slides in an opening in the bellcrank *W*. In ascent, the pawl trips the bellcrank, which in turn forces the stop open for a sufficient time to feed the tubing and to eject the cut piece. The return of the stop permits the oncoming tubing to register. This completes the cycle of operations, which is accomplished at one stroke of the press.

In operation, the press trip is kept depressed and a constant feeding pressure is kept behind the tubing until one length has been used up.

Expanding Mandrels

WILLIAM S. ROWELL

EVEN if holes were bored or ground to accurate sizes, expanding mandrels would still have outstanding advantages over the solid variety, one of which is the ease of mounting and dismounting work without the risk of seizing or scoring either the work or the mandrel, as when a hammer or a press is used to drive a solid mandrel. This is of special advantage in mounting large heavy work that is beyond the capacity of an arbor press or a sledge.

By the simple addition of an adapter bushing, work having almost any diameter of hole may be easily mandreled and the work is likely to run much truer than if a solid mandrel were used. Such adapters are usually made of cast iron and are bored parallel to fit over the outside of the expansion bushing and turned to fit the bore in the work. One slit along the whole length is usually sufficient. Another advantage is the ability to use them in large work having a bore of two diameters when the diameter of the smaller bore is larger than the small end of the mandrel proper. Of course, the great advantage of expanding mandrels over solid ones is their adaptation to bores that are not accurate in size.

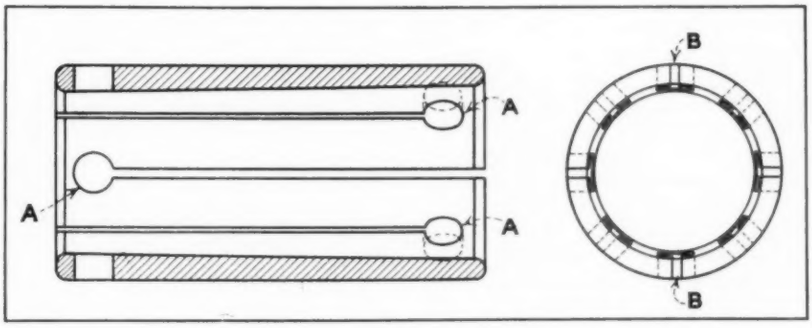
Brown & Sharpe give from 0.005 to 0.007 in. as the permissible expansion for the bushings, which is less than is sometimes necessary, although the material of the bushings has something to do with their permissible expansion.

Well made taper shafts last indefinitely; bushings last a long time and are easily made of a variety of materials. The mandrel itself—the taper shaft—should be made of carbon steel, hardened and then ground to a taper of ⅜ in. per ft. The centers should be ample in size and the corners should be amply rounded. They should always be lapped true after hardening and before grinding to compensate for the spring in hardening. Accurate work requires a relapping of centers after rough grinding the taper body to compensate for the spring that may occur in grinding. At each end a flat should be provided for a dog screw.

The smaller expansion bushings should be made of tool steel and slit in not fewer than four places, each slit terminating in a drilled hole. The larger bushings should have eight slits, as shown in the illustration. The holes *A* should be of ample size to provide conditions for spring and the inner and outer corners should be well rounded. Since slitting expansion bushings does not call for accurate work, it can be quickly done on a bandsaw, but care should be taken not to sawmark the holes and thus initiate breaks. If the bandsaw does not cut straight, the holes should not be drilled until after the most of each saw cut has been made.

If there are any doubts about this being easily possible, let me say that our saw man clamps a bushing to be slit so that the saw enters at *B*, cutting two diametrically opposite slits at the same time, and feeds it forward until the cut is nearly to the drilled holes; reclamping and repeating this process until all the slits have been cut. The viseman who will remove the burrs left by the saw, will carefully finish the saw cuts into the drilled holes, thus avoiding sawmarking the holes.

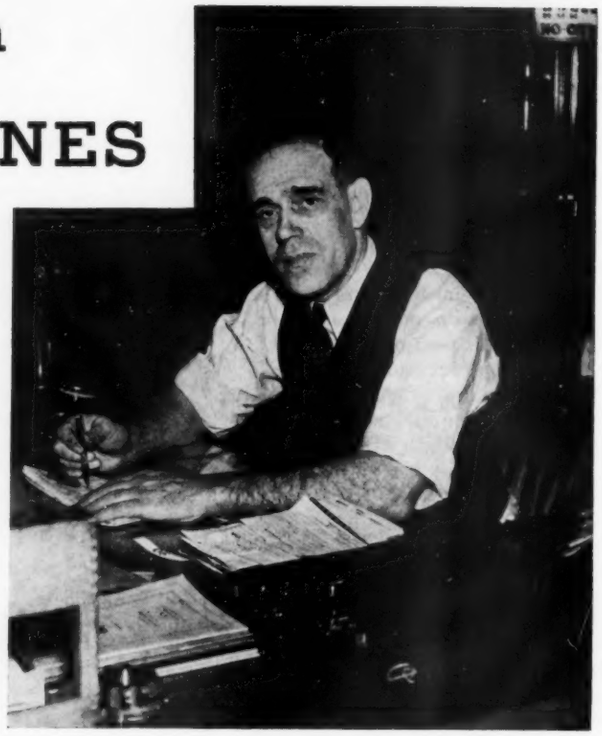
Thin, parallel bored adapter bushings, turned to fit the bore in the work and slit from end to end may be made of any sufficiently tough material. Common iron pipe or old bronze bushings do very well. Cast iron, because of easy working, is best to use for both expansion bushings and adapters of large size.



Expansion bushings can be easily slit by a bandsaw, cutting two diametrically opposite slits at the same time. Care should be taken not to sawmark the drilled holes

TRAINING on MODERN MACHINES

Chevrolet concentrates on shop work in the daytime and requires night school attendance for theoretical instruction



Superintendent of Apprentices Robert Brundle

AT A TIME when apprentice training is of keen interest to all of industry, it is not a new subject to the Chevrolet Motor Company, which has maintained an apprentice course for the last six years. Having established in 1930 a training shop housed in a special building and equipped with modern machine tools, it carried on its program straight through the depression and already has graduated 50 boys from its four-year course. All of these boys are currently employed by the company, three of them having risen to positions as foremen.

Boys from sixteen to eighteen years of age are taken into the apprentice shop; the younger they are the better. They do not have to be high school graduates. They are put on probation for three months and, if they prove acceptable, are then given an indenture contract binding them to go through with the course. If they complete the course satisfactorily, they are given a diploma and $200 in cash.

Chevrolet's apprentice training is definitely a shop training, operated under shop discipline and maintaining shop hours. Boys are on the job nine hours a day (from 6:30 in the morning until 4 in the afternoon) five days a week. The work is all of a practical nature, supplemented by attendance at night school to secure knowledge of shop mathematics, blueprint reading, drawing and allied subjects. The length of time at night school varies with the ability of the individual boy; two years usually is the longest period.

When boys first come into the shop, they are put at the bench to get the "feel" of the tools and to become accustomed to the atmosphere of industrial manufacture. If a boy is alert,

CHEVROLET - FLINT
DIVISION OF GENERAL MOTORS CORPORATION
FLINT - MICHIGAN

SCHOOL RECORD IN SUPPORT OF APPRENTICE APPLICATION

WE DESIRE THE FOLLOWING INFORMATION CONCERNING THE APPLICANT'S ACADEMIC AND PERSONAL RECORD, AND YOUR COOPERATION WOULD BE GREATLY APPRECIATED

NAME OF APPLICANT _____

ADDRESS _____ DATE OF BIRTH _____

THE PUPIL ATTENDED THIS SCHOOL FROM _____ 19__ TO _____ 19_____ AND __

HAS COMPLETED THE _____ GRADE.

MECHANICAL TRAINING RECEIVED _____

GRADES FOR THE PAST YEAR

STUDIES	GRADES EACH SEMESTER 1ST	2ND	3RD	4TH	STUDIES	GRADES EACH SEMESTER 1ST	2ND	3RD	4TH
ENGLISH					FOREIGN LANG.				
ALGEBRA									
ALGEBRA, ADVANCED									
GEOMETRY, PLANE					GENERAL HISTORY				
GEOMETRY, SOLID					MED. & MOD. HSTRY.				
TRIGONOMETRY					ANCIENT HISTORY				
					U. S. HISTORY				
PHYSICS									
CHEMISTRY					MANUAL TRAINING				
BIOLOGY					MECHANICAL DRAW.				
GENERAL SCIENCE					AUTO SHOP				
					OTHER MECHANICAL				
CIVICS					TRADES COURSES:				
ECONOMICS									
DEPORTMENT									

INDICATE YOUR ANSWER TO EACH QUESTION BY PLACING (X) OR OTHER PROPER NOTATION IN SPACE PROVIDED:

1 SCHOLASTIC RANK IN HIS CLASS: 1ST SEMESTER _____ 2ND _____ 3RD _____ 4TH _____

2. ATTITUDE TOWARD SCHOOL WORK: ENTHUSIASTIC ___ INTERESTED ___ AVERAGE ___ INDIFFERENT ___ POOR ___

3. HOW WOULD YOU RATE HIS AMBITION? SEIZES EVERY OPPORTUNITY _____ AMBITION IS DEVELOPING _____ SEEMS TO HAVE LITTLE AMBITION __

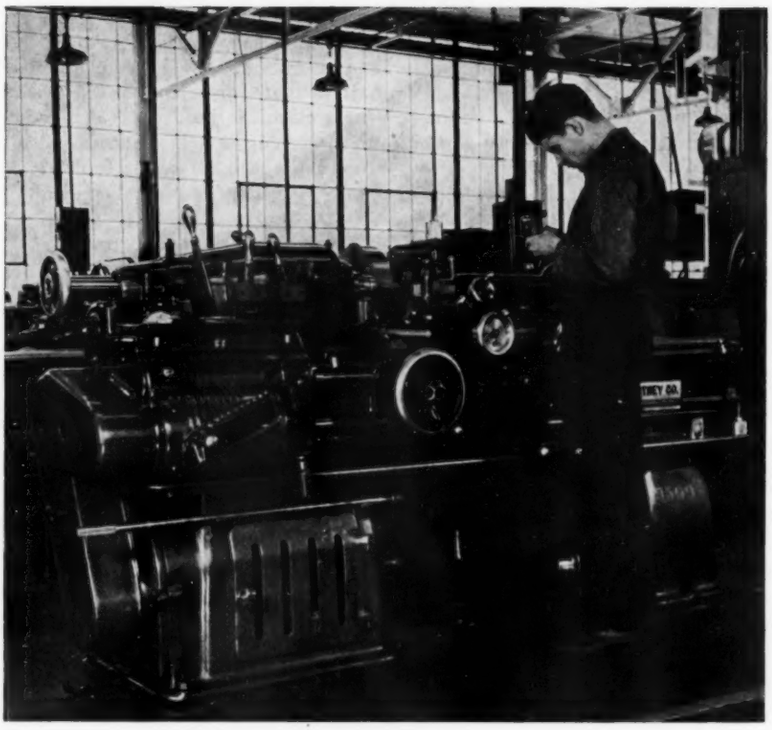
4. HIS MECHANICAL ABILITY IS: OUTSTANDING _____ GOOD _____ AVERAGE _____ FAIR ___ POOR ___

5 EVIDENCE OF FUTURE VALUE: EXCEPTIONAL PROMISE _____ GOOD TIMBER _____ AVERAGE _____ QUESTIONABLE PROMISE _____ NONE ___

6. WOULD YOU RECOMMEND HIM FOR THE CHEVROLET APPRENTICE SHOP? VERY WILLINGLY ___ RELUCTANTLY ___ NOT AT ALL _____

DATE _____ SIGNED _____

(FOR ANY ADDITIONAL REMARKS, USE THE REVERSE SIDE.)



Equipment in the apprentice shop is up to date and the policy is to keep it that way

APPRENTICE APPLICATION
FOR
GENERAL MECHANICAL TRADE

CHEVROLET - FLINT
DIVISION OF GENERAL MOTORS CORPORATION
FLINT - MICH.

NAME _____ AGE _____
LAST FIRST MIDDLE

FLINT ADDRESS _____

HOME ADDRESS _____

PLACE OF BIRTH _____ DATE OF BIRTH _____ 19__

PARENTS OR GUARDIAN'S NAME _____ RELATIONSHIP _____

PARENTS BOTH LIVING? _____ FATHER'S OCCUPATION _____ WHERE EMPLOYED? _____

EDUCATION

WHAT SCHOOL ATTENDED _____ HOW MANY YEARS? _____ GRADE COMPLETED _____

STUDIES ENJOYED MOSTLY IN SCHOOL _____

DO YOU CONSIDER YOU HAVE NATURAL ABILITY FOR MECHANICAL TRADE? _____

WHAT HAVE YOU EVER DONE TO EARN MONEY? _____

REFERENCES

NAME _____ ADDRESS _____ OCCUPATION _____

1. _____

2. _____

3. _____

EVERY APPLICANT ACCEPTED MUST PROVIDE A BIRTH CERTIFICATE.

ALL QUESTIONS MUST BE ANSWERED IN YOUR OWN HANDWRITING IN INK

IF MY APPLICATION IS ACCEPTED, AND WHEN MY TRAINING STARTS, I AGREE TO TAKE SUCH NIGHT SCHOOL COURSES AS MAY BE DEEMED NECESSARY BY MY INSTRUCTORS.

SIGNATURE OF APPLICANT _____

SIGNATURE OF PARENT OR GUARDIAN _____

DATE _____

Forms used for applications and for reporting school history of would-be apprentices

one month is long enough for him to become acclimated, after which he goes on lathe work for approximately four months. From the lathe he progresses to the milling machines and shapers for three months and thence to the grinding machines for a similar period. At this point he is given around three months of experience in heat-treating. Six months at the bench, repairing equipment and rebuilding machinery, follow.

By this time (at the end of fifteen months) the boy has a fairly good conception of what is done in a machine shop and has become reasonably adept at handling tools. He therefore retraces the ground which he already has covered, working on more complicated jobs and understanding as he goes along why he is doing certain things. During the last few months of the course he is often used as a utility man around the shop, being placed wherever he can do the most good.

Program Is Flexible

There is no set rule that a boy shall stay on a specified job or machine for a certain length of time. The apprentice school superintendent, however, has in mind a period of training on various machines corresponding to the number of months already listed. Boys who stand out from the group in intelligence and initiative are given an extra course in pattern making in a department of the shop devoted to that work. Machinery also is rebuilt in this department.

Each apprentice is required to work a total of 7,280 hr. during the four years of training, divided into eight periods of 910 hr. each. When he starts out, he is paid 38 cents an hour, the amount increasing each period until at the end he is receiving 50 cents an hour. If he works overtime, he is paid the same rate of overtime as regular production employees. Upon entering the course, he is supplied with a kit of tools and measuring instruments by the management at cost.

A committee of three executives, consisting of the superintendent of the apprentice shop, the personnel director of the company and the superintendent of a production department in the plant, selects all boys applying for entrance. The boy fills out a formal application, which provides among other things that he agrees to take such night school courses as his instructors

think necessary. At the same time he is given a thorough physical examination, the examining physician indicating whether the boy is physically fitted for heavy, average, moderate or light work.

The committee secures from school authorities where the boy went to school a detailed report of his record, giving his grades in various subjects and commenting on his deportment. They are asked to rate his ambition, his mechanical ability, his future value and his attitude toward his school work. Incidentally, it has been found that if a boy's conduct in school has been bad, it is difficult to do anything with him in the shop, whereas if his conduct has been good but his grades only fair, the management can afford to take a chance on his turning out to be successful.

Close Supervision

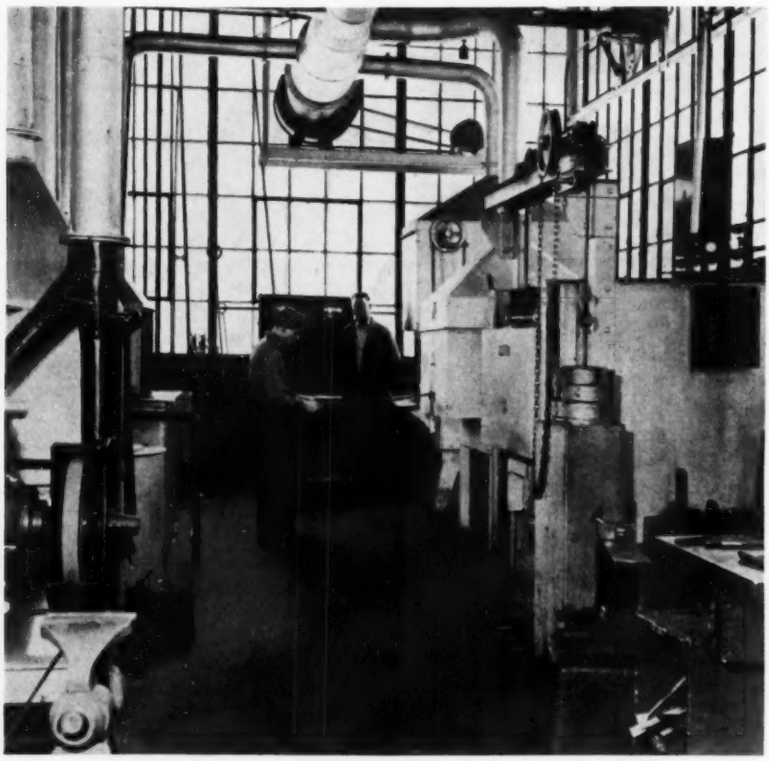
There are five instructors in the shop, or one for every ten boys. This low ratio gives the instructor a chance to help the boys personally and keep close watch on their progress. All instructors are men selected because of their good judgment, good moral standards and shop experience. They do not have to be college graduates. Very young men are barred, because they aren't mature enough to command the respect of the boys. The main essential in the instructor is to be broad-minded and to have a sincere desire to give the boys under him a real chance to show what they can do.

From the beginning, the shop has done work of value to the company rather than confining its scope to nonproductive activities. It has the privilege of drawing work from any department of the plant. It makes some parts for jigs and fixtures, as well as handling die and machine repair jobs. It also builds special machinery for production departments; for example, it is now making a special machine for cutting off the ends of valves.

Shop equipment consists of the following machines:

4 millers	3 screw machines
1 spliner	1 surface grinder
1 boring mill	1 internal grinder
1 planer	1 cutter grinder
1 slotter	3 cylindrical grinders
2 shapers	1 radial drill
16 lathes	2 bench lathes
1 bench drill	3 upright drills
1 bench miller	

In the heat-treating department are an electric carburizing furnace, a preheating furnace and a high-speed furnace operating on high-pressure gas, and a cyanide pot furnace and lead bath furnace operating on electricity. One section of the shop is devoted to wood-working and is equipped with a wood lathe, a band saw, a table saw, a jointer, a planer and a drill press.



Every boy gets detailed instruction and practical experience in the hardening room

Equipment Up-to-Date

All machinery in the apprentice shop is modern, a considerable amount having been purchased in the last six months. The company is operating the shop on the theory that it is wasted time for it as well as for the boy if he is taught the mechanics of running machines of obsolete design. A constant check is made to see that the equipment is kept up to date and in good shape.

The apprentice shop occupies a building 60x140 ft. which is well lighted and ventilated. All benches are on the north side of the structure so that boys don't have to work in shadows as they would on the south side where sunshine penetrates.

Each boy is given a book in which the record of his progress is kept. It tells the purpose of the course, reprints the indenture contract and the forms of application for admission to the shop. In it is recorded by the instructors such characteristics as attitude toward work, workmanship, cooperation, conduct, reliability and evidence of future value. There are several pages on which the boy's earnings are to be recorded. The boy must turn in this book for a rating at the end of each 910-hr. period.

Future Executives

Chevrolet figures that its apprentice shop pays its own way. That is, at apprentice wages and with proper supervision, the boys can produce full value for the actual cash outlay made in operating the shop. There are other advantages, however, apart from a dollars-and-cents measure of the shop's worth. The company feels that after four years of training at good wages and under favorable working conditions, boys will have a solid groundwork on which to develop their special abilities. From their ranks should come future shop executives. Their loyalty and understanding of their jobs will be worth many times the temporary allegiance of fly-by-night workers who shift constantly from one industry to another and from one company to another in the same industry.

DIE DESIGN *and* DIE MAKING

III — Where blank dies must have a life of 250,000 parts sub-press construction is recommended

E. G. MARSHALL
Master Mechanic, Charleston Works, The American Fork & Hoe Company

HIGH-PRODUCTION dies require the use of sub-presses, to maintain accuracy and give the desired output. Some firms make their own sub-presses, but usually these are purchased from concerns specializing in their manufacture. In the latter case, sub-presses are known as "commercial die sets," which consist of a punch holder, a die shoe, and two or more guide pins to hold the upper member in alignment with the lower one. The self-oiling type is preferred.

There are certain things to check with reference to die sets. They should have guide bushings of tool steel, hardened and ground. Guide pins should be a good sliding fit in the bushings. To check the play remove the upper member from the lower one and try one end over one pin at a time. If there is plenty of play on each pin and the upper member moves stiffly on the pins when assembled, the center to center distance of the pins and bushings is not correct, or the pins are not vertical with the base and parallel with each other.

The guide pins should be as long as possible, but not long enough to be struck by the ram in the down position. The bushings should be long enough so that the pin always engage them. In other words, the upper member should never raise off the pins, which would allow it to move frontward or backward, and thus cause breakage when the press is tripped.

In starting the design of a blank die, the designer should use the following procedure: lay out the blank completely and correctly to scale. Establish the stock advance. Calculate the

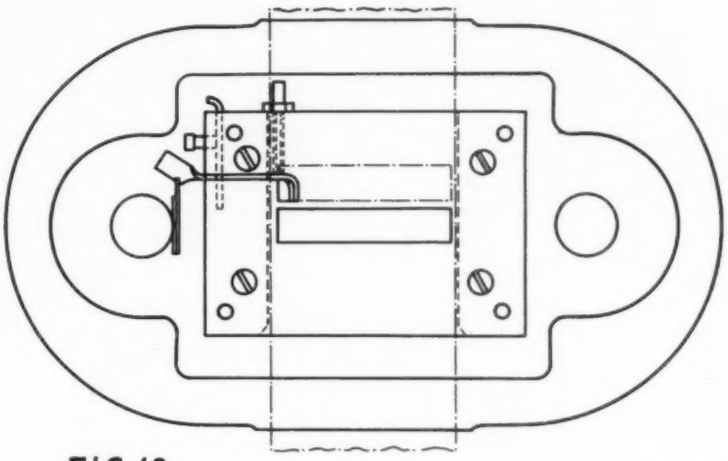


FIG. 10

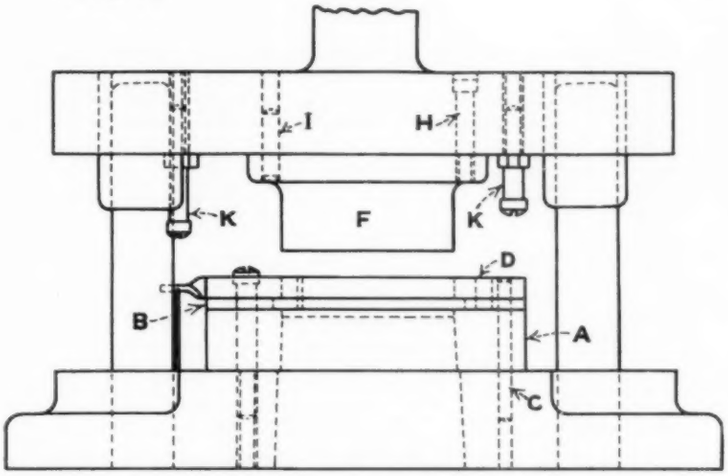


Fig. 10—Because the upper and lower die members are accurately aligned and guided by the sub-press, the press proper does not have to be in as good condition as with unmounted blank dies

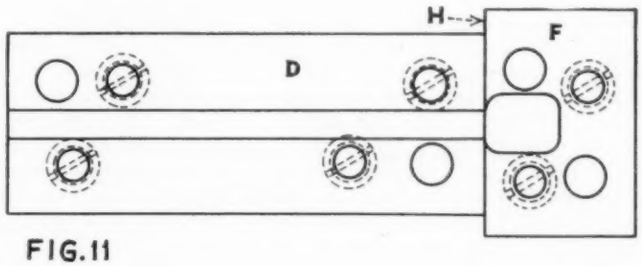


FIG. 11

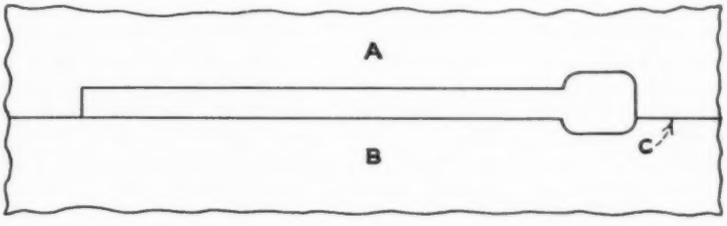


Fig. 11—Losses from distortion are avoided and easier fitting and machining are secured by making the punch and the die in sections

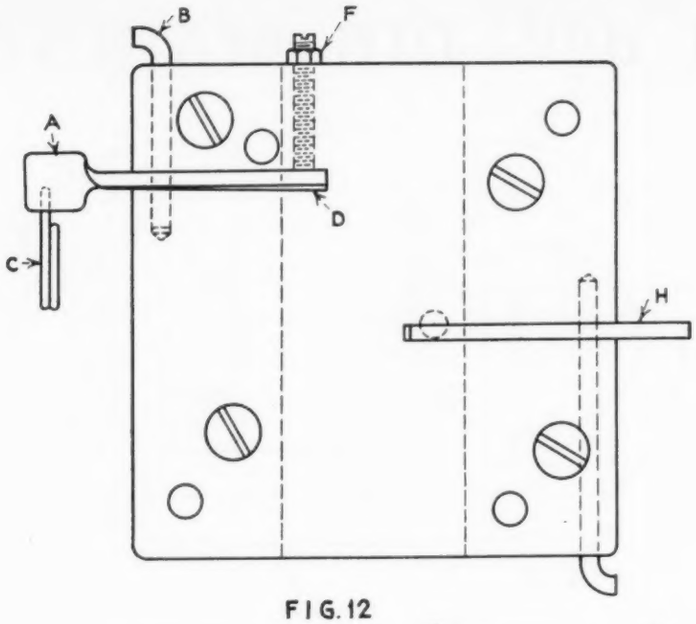


FIG. 12

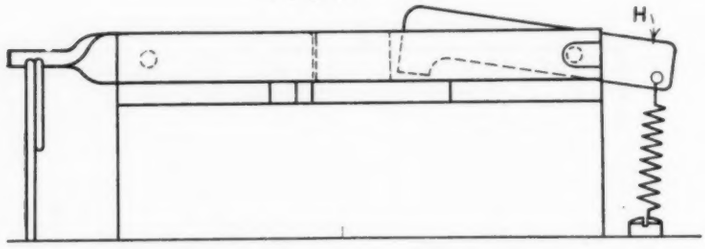


Fig. 12—At the left is an automatic stop that engages the blank opening and is actuated by a pin on the punch holder. At the right is one type of a first blank stop for progressive dies

number of tons pressure required to blank the part. Decide the width of the raw stock and the temper to be used. The area of the blank should be determined.

After the tonnage and shut height of the punch press are established the subpress can be established. The shut height of the punch press is the distance from the top of the bolster to the bottom of the ram, with the stroke of the ram down, and the ram adjustment up. The thickness of both members of the sub press, the thickness of the die block and the length of the punch should be decided before the designer starts the actual drawing of the die. The width and length of the die shoe should be large enough so that with the clearance hole for the blank there will be strength enough to eliminate danger of breakage.

A typical blank die of sub-press construction is shown in Fig. 10. Die block *A* is shaped to 1⅛ in. thick, and ground on top to get a smooth surface for layout. This die block can be made by the same method as for unmounted dies, except that the sides do not have a 10-deg. clamping angle. Mount the die block on the sub press so that the hole is as close to center both ways as possible. Stock guides *B* have the same relation to the stock position on the die block as with the unmounted die. See Fig. 6 (*AM*—Vol. 80, page 305).

The stripper is a ⅜-in. cold-rolled plate located and attached to the die block in the same manner as with the unmounted die. Dowels employed are of two lengths. Dowels *C* located in opposite corners are long enough to go through the stripper, stock guide and die block, and into the die shoe at least two diameters of the pin. Dowels *D* are only long enough to hold the stock guides in line with the stripper.

The dowels are made of tool steel, hardened and ground to plus or minus 0.0002 in., and they must be straight and round. The dowel holes in the die block should be ground or lapped straight and round. If the dowels are too loose a drive fit they will fall out, and if too tight they will gall the hole. The stripper screws have their heads entering half-way into counterbored holes, and pass through clearance holes in the stripper, stock guides and die block, and are screwed into the die shoe.

Punch *F* is attached to the upper member and is made in the same manner as for unmounted dies except that it is screwed and doweled to the upper member. The dowel holes are drilled and reamed small enough to allow lapping or grinding stock. Screw holes are tapped 0.003 in. oversize to take care of distortion in hardening. After hardening the punch is clamped on the upper member and located in line with the die hole, and the screw and dowel holes are transferred from the punch to the punch holder.

The screws *H* are put in from the top so that they can be tightened more readily when the sub press is together. Dowels *I* are drive fit into the punch and punch holder. The fillister-head screws *K* are limit screws to limit roughly the downward stroke of the upper member so it will not travel far enough to break the automatic stop.

Sectional Punches and Dies

There are many cases of expensive dies where it is cheaper and easier to machine the punch and die block in sections. Moreover, the sections are less likely to distort in hardening. Fig. 11 is an example. The die block was made in two pieces, *A* and *B*, joined together on line *C*. If made in one piece, the outline would have to be drilled and filed, and if distorted badly in hardening it would be lost. Even a slight distortion would cause hours of stoning. As shown, however, the two pieces can be milled to size and hardened without trouble. Then they can be ground all over if necessary and ground at the parting line to make the opening smaller if desired. When the tonnage is high it is recommended that the sections be sunk into the die shoe.

The punch is made in two parts also, as at *D* and *F*, joined at line *H*. Hours of hand fitting have been saved in this case, as the punch would be hard to machine in one piece. It would be necessary to rough machine, shear into the die block, and then finish largely by hand. The part would distort in hardening and the amount of stoning and fitting would be a problem. By making the punch in two parts, piece *D* can be rough machined, hardened and then ground all over to fit the die. This is the best method to get a good fit. Piece *F* is finished in the same way except for fitting the radii. The parting line

should be ground so that both pieces fit the length of the die opening. They can then be mounted on the sub press.

The automatic stop shown in Fig. 10, and also illustrated in connection with unmounted dies, see Fig. 9 (*AM*—Vol. 80, page 307), is shown in greater detail in Fig. 12. Stop *A* is pivoted on pin *B* and is returned by spring *C*. The stop is made of cold-rolled steel and after fitting it is case hardened. Pin *B* is made of drill rod and hardened. Spring *C* must be made to suit the pressure both upward and sideways on the automatic stop.

Operation of the automatic stop is as follows: the stock is shoved forward until it strikes the stop. The spring holds the working end down against the die block and forward against the clearance shown at *D*. However, the stock shoves it back against the adjusting screw *F*. When the actuating screw or pin on the upper member comes down, it pushes down on the outer end of the stop and causes the inner end to be raised. Meanwhile the spring forces the stop forward again, taking up clearance *D*. When the upper member rises again the spring forces the inner end of the stop down. Because the stop has taken up clearance *D* the end comes down on top of the strip. Thus, the stock is free to be shoved forward until the stop falls through the next blank opening and catches again.

The position of the stop should be such that it has a clear travel across the blank opening. If it should catch on an irregular outline it would prevent the correct stock advance. The stop should be placed on the left side of the die because it is then closer to where the operator stands. It also is unnecessary then to reach across the die, which is dangerous.

A Manual Stop

At *H*, Fig. 12, is shown a manually operated stop which is used when starting the strip in a progressive die. It positions the stock for piercing, after which the strip is moved forward to stop *A* for blanking. From this point on stop *A* funtions in the blanked holes.

Fig. 13 shows a double-run die using an automatic stop, a notching punch, and a first blank stop. When the outline of the blank is such that a single-run die causes large stock waste, the layout can sometimes be changed for a double-run die and most of the waste saved. In Fig. 13 the stock is shoved in against the automatic stop *L* and when the punch press is tripped the punch *N* cuts a notch in the edge of the strip for the next position of the automatic stop. When the stock is run through the second time, the first blank stop *M* is put by hand into the notch made by punch *N*. After the first blank stop *M* is no longer required, the notching punch and the automatic stop *L* taking care of the stock advance. Note that the stock guide on the left is made in two pieces to allow room for the stop.

Stop *L* is made slightly thinner than the stock guide in order to move freely. A dowel holds the stop in place and limits its travel. There is clearance sideways so that the stop can be pulled sideways, and the point swung forward ahead of the notch. It then can slide along the edge of the strip to the next notch. At this point the spring causes the stop to move in and engage the notch. The stop is made of cold-rolled steel and casehardened.

Actuation of stop *L* is secured by a taper-ended screw *O* in the upper member. This screw is made from a standard fillister-head screw and casehardened. The first blank stop is made of thin cold-rolled steel about half the thickness of the stock guides. It is

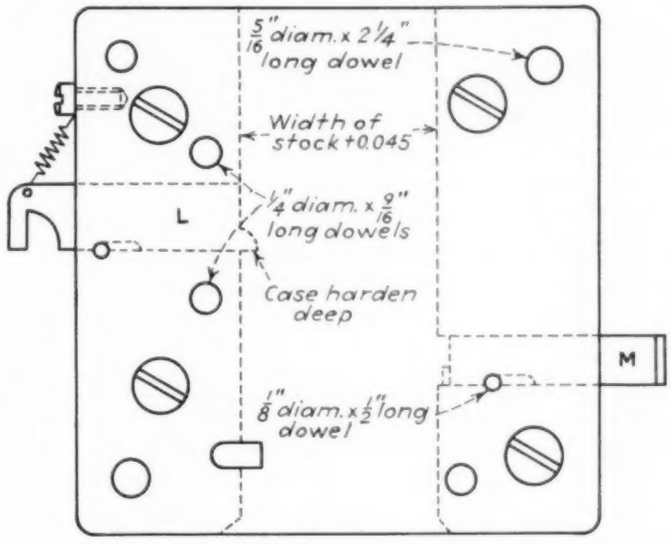


FIG. 13

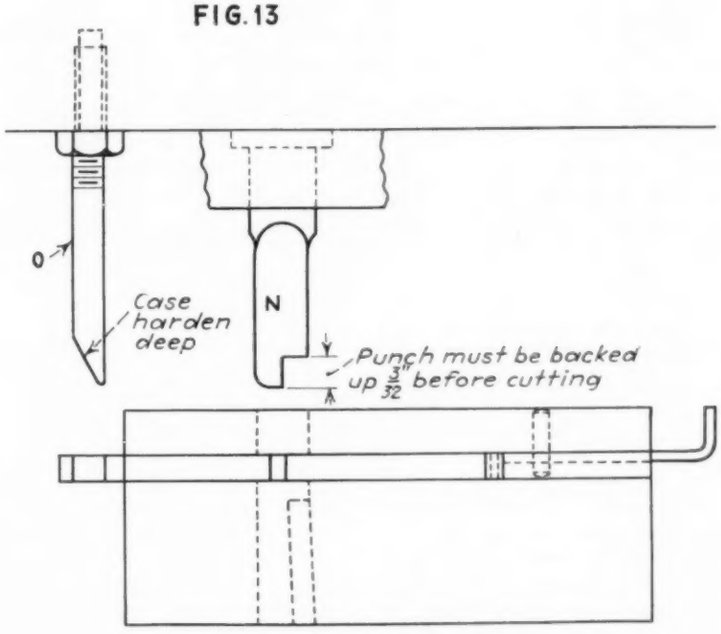


Fig. 13—At the left is another type of automatic stop that engages a notch punched in the side of the strip. At the right is a second type of first blank stop

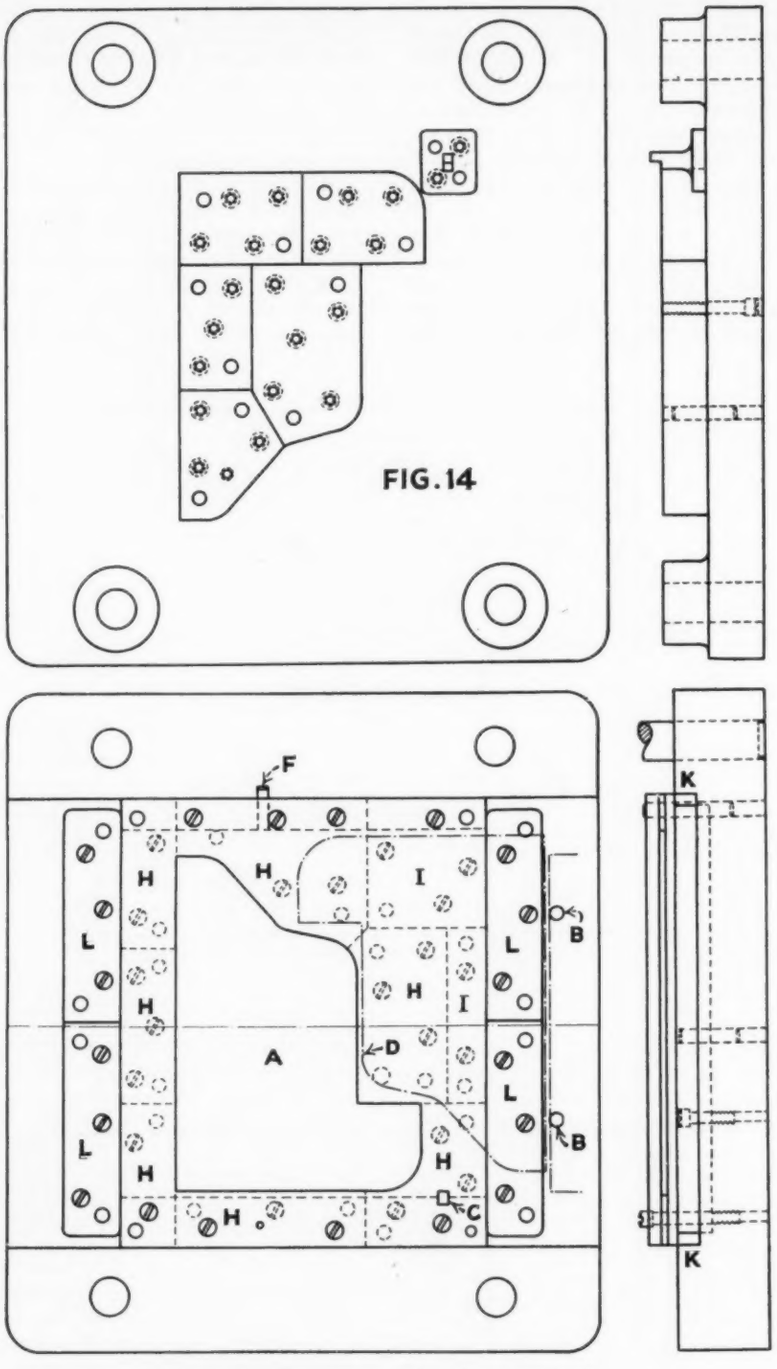


Fig. 14—The sections of a large sectional die must be backed up by other blocks and sunk into the die shoe to prevent shifting

also casehardened. A dowel prevents it from being pulled out and lost.

Large die blocks are frequently made in sections to overcome machining and heat-treating difficulties. There are many different sizes and styles of sectional dies, but the one shown in Fig. 14 gives the general principle. To get a good idea of the size of the die the stock advance is dimensioned. The direction of stock feed is also shown.

This die is laid out as a double-run type. The blank opening is shown at *A*. For the first run the stock is entered from the left and shoved through the die to pins *B*. After the first blank the stock is raised to pass over these pins until the blanked opening limits against them. Pins *B* are used as stops throughout the first run. Punch *C* cuts notches used for locating the strip during the second run.

The stock is turned end for end for the second run, but is not turned over. The first blank openings are now represented by *D*, shown in phantom. Manual stop *F* is caused to engage the notches cut by *C* during the first run, and pins *B* are not longer used. Punch *C* cuts during the second run, but the notches so produced are not required.

Sections of the die are machined and then hardened and ground to correct dimensions and locations. Sections *H* are made of a good grade of tool steel, while Sections *I*, also made of tool steel, act as back up blocks for the cutting sections. The sections are backed up and prevented from spreading by being sunk into the die shoe at *K*. On the other two sides the sections are backed up by the blocks *L* which are also sunk in the die shoe. Blocks *L* are made of machine steel. The stock guides are mounted in the same manner as described for other blank dies. Clearance between the strip and the stock guide is not equal on both sides of the strip because of the double-run construction.

All sections of the punch are made of tool steel and they are so made as to support each other. These sections are ground all over in fitting to the die block. There is no heel on the back of the punches because they are large enough to have the dowels and screws come on the inside. The dowels must be fitted very carefully and be rather tight in order to hold the sections securely in location.

Part IV of *Die Design and Die Making* will appear in an early number.

Profiles for Propellers

Cutting the profiles in metal blocks for airplane propellers accurately to 0.002 in. is the work of a new machine designed and built by Engineering and Research Corporation, Washington, D. C., according to the *Electromet* Review. This machine profiles only one side of the blade at a time, unlike the copying lathe commonly used. A cutter with a peripheral speed of about 5,000 ft. per min. will remove $\frac{3}{8}$ in. of metal in one cut if necessary.

To maintain the high accuracy required, the machine is equipped with an extremely rigid welded steel base fabricated by Lukenweld, Inc. Lathes are of Cromansil steel, selected because the high Brinell hardness of this material assures long-wearing surfaces.

Editorials

AMERICAN MACHINIST ESTABLISHED 1877
VOLUME 80 NUMBER 9
K. H. CONDIT • F. H. COLVIN
EDITORS

THE BURDEN OF RELIEF

IN the heat of argument over the great administration tax proposal that is to raise the money needed to balance the "regular" federal budget without alienating votes, attention has been diverted from an even more serious burden, the relief bill. How important the granting of additional relief money for the administration to spend before election day is may be gathered from the latest poll of the American Institute of Public Opinion. President Roosevelt has gained slightly in the latest count. His support comes largely from those on relief of one sort or another. The business, industrial and professional groups are against him.

Obviously the relief appropriation will go through speedily regardless of private wars between PWA and WPA czars, or of disclosures of graft in the use of relief money such as that of Senator Holt of West Virginia. The administration forces in Congress are too strong to be stopped, and the political need is too great to be denied.

A lot of people think that business is going to pay the bill for relief. It is, but what is business but the joint activity of the people themselves? Every dollar assessed against a corporation comes out of the pockets of its employees and its stockholders in the end. The present tax proposal is bad enough, in all conscience, but it is only a flea bite compared to the relief bill, already charged and yet to be voted.

No one grudges relief to those unfortunates who truly need it. But those of us who can see beyond the ends of our noses are desperately concerned over the enormous wastes of our money that are chargeable to the federal relief bureaus, and over the padding of relief rolls that has been going on everywhere. If you have doubts read the portions of General Johnson's suppressed WPA report that have leaked out. They are only what might be expected from a realistic critic.

HERETOFORE the rebuttal of New Dealers to accusations of inefficiency and waste has been "Well, how would you have done it?" Ever since the relief program was begun, under the friendly political guidance of Mr. Farley, some of us have felt that it would have been far better to handle it through a seasoned relief agency, The American Red Cross. But because of the size of the job we were just a little dubious that the Red Cross could swing it. We know better now. The magnificent accomplishments of the Red Cross in handling relief in the flooded areas and in the tornado regions of the South has proved that it could have handled depression relief, free from politics and with a minimum of waste.

How much more of the Hopkins-Roosevelt type of relief can business and the country support? Don't forget that there is another "blank check" demand before Congress now.

Aerial Advances

THREE bad accidents with loss of life have clouded the good record of aerial transport operations in the last few days. So far as we can tell two of the three were not caused by failure of the plane or its engines. The third may have been.

On the credit side of the ledger for the transport companies is the splendid emergency job done by them in carrying passengers, food and medical supplies into and out of the flooded areas when surface transport was blocked. Also an item reported by B. C. Forbes of a rush job done by aerial express. A machine part for a construction job twenty miles from Honolulu was needed before work could continue. The superintendent radioed for the new part on the thirteenth of the month. It was finished two days later and put aboard a transcontinental plane at the Newark Airport. Twenty-four hours later it was handed to the crew of the China Clipper at Alameda and within another day was in the hands of the construction superintendent.

One-third of the way around the earth in two days is real speed. Such mechanical and organization triumphs must be counted in when we try to evaluate aerial transportation.

Chips

WASHINGTON — President Roosevelt returns from his fishing vacation and tells young Democrats at Baltimore that he is for working age limits of 18 to 65, shorter hours and more experiments . . . Unemployed form union at Washington convention, have to be thrown out of House . . . Hearst loses D. C. court suit against Black lobby committee, House refuses money for extra legal fees to defend Black committee . . . WPA preparing plan for direct relief if Congress throws out "made work" . . . Sidney Hillman starts campaign to deliver labor vote to Roosevelt . . . House passes bill authorizing 10-year rural electrification program . . . Hopkins promises that no WPA money will go to Passamaquoddy power or Florida canal projects as he holds back Gen. Johnson's report condemning WPA achievements, and Roosevelt confirms his statement . . . Congress concentrates on taxes and relief . . . RFC flood rehabilitation loan bill passed and signed.

FOREIGN—France would have commission rule Europe for 25 years to maintain peace . . . Germany says it's too complicated . . . Mussolini demands annihilation of Ethiopian armies but they are hard to catch . . . England tense as Italians reach border of British colony . . . Herriot warns French not to expect help from U. S. because of debt repudiation . . . Mexico deports Calles, former dictator, unceremoniously and unexpectedly by plane . . . Locarno powers meet in new League of Nations palace in Geneva, reconcile some French and English differences about German attitude, give Italy little encouragement on lifting of sanctions . . . Moscow makes the not very novel observation that Hitler is trying to split nations opposing him . . . Latin-American countries urge League of Nations for the Americas . . . Soviets call 8,000 boys for flying training . . . Belgian, British and French military chiefs meet in London . . . League figures show how sanctions strangle Italian trade.

FINANCE — Treasury announces it is prepared to pay bonus certificates on June 15 . . . RFC will set up loan agencies in flood and tornado districts.

INDUSTRY—New York Central orders seven diesel electric switchers from Electro-Motive Corp. for use in Chicago yards . . . Milwaukee orders another Hiawatha type locomotive from American, will build 1,500 cars in its own shops . . . Santa Fe orders 8-car stainless steel train from Budd to make the Chicago-Los Angeles run in 39 hrs. 45 min. . . . Louisiana & Arkansas orders five oil-burning locomotives from Lima . . . Mesta gets equipment order for Jones & Laughlin $25,000,000 continuous strip mill . . . Large number of "interruptions" of ships and several crew strikes presage investigation of merchant marine . . . Eastern railroads continue fight on ICC fare reduction order but several state commissions indorse it . . . Labor Board refuses to act in aluminum union jurisdictional dispute, tells unions to settle their own row . . . NRA report urges continuation of non-profit shops for the handicapped . . . P.R.R.'s flood loss put at $12,500,000 . . . Automobile manufacturers resign from U. S. Chamber, join N.A.M. . . . Western shipping lines break with Bridges union . . . Court upholds New York State unemployment insurance law.

TRADE—Survey inaugurated in anticipation of reciprocal trade treaty with Great Britain.

INDICATORS — Steel production up sharply, reaching highest point since July, 1930 . . . Electric power output reaches new record in more than seasonal gain . . . *Business Week's* index at 71, up 3½ points in two weeks.

Engineering Foundation Spurs Welding Research

Col. C. F. Jenks Heads Group to Coordinate All Studies

Plans to expand its organization for the advancement of welding have been announced by the welding research committee of the Engineering Foundation, 29 West 39th St., New York, N. Y. The welding group is headed by Colonel C. F. Jenks, commanding officer, Watertown, Mass., arsenal, and seeks to coordinate the work being done in this field. Already 60 investigations, guided by a subcommittee on fundamental research, are reported underway in various universities and technical schools. Many more researches are being carried on in federal and industrial laboratories.

Divisional committees are being organized to work with the group headed by Col. Jenks in studies of welding in special fields, under the following chairmen already appointed:

J. H. Critchett, vice-president, Union Carbide & Carbon research laboratories, welding low carbon steels; H. C. Jennison, technical manager, American Brass Co., copper alloys, and J. H. Hodge, chief metallurgist, Babcock & Wilcox Co., carbon steel. Other groups on welding problems of cast iron, high alloy steels, aluminum alloys and nickel alloys will be formed, making seven.

Three functional committees have been formed on methods of test, headed by Professor M. F. Sayre, Union College; analysis of weld failures under W. D. Halsey, assistant chief engineer, Hartford Steam Boiler & Insurance Co., and weld stresses and their cause and effect, of which E. Chapman, vice-president, Lukenweld, Inc., is chairman.

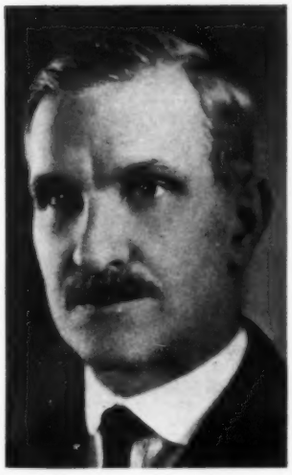
Another committee, also headed by Mr. Critchett, will digest all the technical literature on welding, and will make it available to American industry. H. M. Hobart, consulting engineer, General Electric Co., is chairman of a committee fostering welding research in universities.

HEADS SCOTT & WILLIAMS

Walter L. Toy Elected to Succeed Late Head of Textile Machinery Maker

Walter L. Toy, since 1929 vice-president of Scott & Williams, Inc., Laconia, N. H., knitting machinery manufacturers, has been elected president, succeeding the late Harry B. Swinglehurst. Mr. Toy has been with the company for more than 25 years, and is active in the industry's associations. He has served as manufacturing and sales executive.

Welcomes Gear Men



GEORGE L. MARKLAND, JR.

GEORGE L. MARKLAND, JR., past president of the American Gear Manufacturers Association, and president of the Philadelphia Board of Trade, welcomed the delegates to the 1936 A.G.M.A. convention April 20, at the Hotel Adelphia. Mr. Markland founded the Philadelphia Gear Works, and for years has been a leading figure in the industry.

FORD LAMB ELECTED

Tool Engineers Choose Machine Tool Manager Society's President

FORD LAMB, Detroit district manager, Consolidated Machine Tool Corp. of America, Rochester, N. Y., has been elected national president of the American Society of Tool Engineers, Detroit. FRANK SHULER, master mechanic, Chrysler Corp. Highland plant, and LUKE BEACH, Packard Motor Car Co., were named vice-presidents; RAY BRUNNER, Dodge Bros. Corp., was elected secretary, and FRANK CRONE, Lincoln division, Ford Motor Co., was elected treasurer.

BONUS & VACATION PAY

Allis-Chalmers Announces Plan Affecting 10,000 Employees in All Plants

Allis-Chalmers Mfg. Co. has inaugurated vacation with pay for its 10,000 employees, and a $500,000 Christmas-bonus plan for its 8,000 shop workers, Max Babb, president, announced. The bonus will be 3 per cent of wages earned between March 1 and December 1, 1936. Employees are on a 40-hour week. Beside the main plant at West Allis, Wis., the company has plants in LaCrosse, Wis., La Porte, Ind., Springfield, Ill., Norwood, Ohio, Pittsburgh, Pa., and Boston, Mass.

Mesta Machine Gets Big Steel Mill Job

Machinery Awarded for $25,000,000 Continuous Strip Plant

The Mesta Machine Co., Pittsburgh, Pa., will build the machinery for the Jones & Laughlin Corp. new $25,000,000 electric sheet and strip mill. General Electric Co. has received the contract for motors and generators.

The plant will be Pittsburgh's first continuous strip mill, and 1,200 extra men will be employed to operate the plant making strip for the automotive, refrigerator and air conditioning manufacturers.

Contracts for the building and other equipment will be let soon.

FORD WAGES

Official Reports Average Shop Pay Was $1,372 in 1935; Employs Older Men

The average wage of all shop employees of the Ford Motor Co. for 1935 was $1,372.58, William J. Cameron of the company's executive staff, said. During 1936, he said, under the company's $6-a-day minimum, a man cannot earn less than $1,500 if he works a full year of about 255 working days. He said the 76,799 records examined showed that 76 per cent of the men earned $1,200 and over. No salaried men were included in the study.

Answering the report that the Ford Motor Co. will not employ men over 40 years of age, Mr. Cameron said that the percentage of men over 40 had shown a gain in 1935, as had the percentage of men employed over 50.

Fifty-nine per cent of the employees worked 52 weeks during the year, and 81 per cent worked more than 40 weeks, Mr. Cameron said.

DIE CAST EXHIBIT

The most comprehensive exhibit of die-cast products ever staged has been installed at Metals Products Exhibits, Rockefeller Center, New York, N. Y., under the auspices of the American Die Casting Institute. The display, contributed by 25 producers, includes automobile parts and fittings, tools and machinery parts, clocks, novelties and household products. It closes in May.

TRACTOR OUTPUT UP

Tractor production in the United States reached a total of 158,460 units, valued at $120,809,833, or an increase of 114 per cent over the 1931 figure, the Department of Commerce reported.

Motors AND OTHER MATTERS

Despite weather, car sales continue feverishly . . . Bonus payments will aid . . . Chrysler tooling for new six . . . Ford leaning toward all-steel top, according to rumor . . . Frameless bodies due

BURNHAM FINNEY
Western Editor

DETROIT—Retail car sales have come along with such a rush in the last month that it has almost taken the industry's breath away. In spite of rainy and cold weather, orders have poured into factories in such volume that production is unable to keep pace with sales. Car makers have "turned the heat" on parts and materials suppliers to ship in as much as they can. Where sheet and strip mills have been unable to furnish the tonnage as rapidly as wanted, business has been shifted to other sources.

Car manufacturers don't look on this sudden spurt as a "flash in the pan." A number of them are convinced that the remarkable buying wave, without the stimulus of good weather, is a forerunner of excellent business during May and June, with the year's peak coming later than April. Even those who believe the present rate can't hold through next month, expect a brisk retail demand up to August. They are counting on bonus payments to act as a "shot in the arm" to a declining market. Competent observers estimate that veterans will spend part of their money for around 500,000 new and used cars. Then cash disbursements to farmers by the administration, plus crop money, should give dealers in agricultural districts a thriving summer trade.

All Makes Are Selling

Practically all companies are participating in the selling spree, although General Motors seems to have an edge on the others. Chevrolet leads by a wide margin. Last month was its all-time peak, with a fresh record about to be set this month. While Ford may appear to be lagging, it is reported to have built 110,000 cars during March and will surpass that figure in April. Universal Credit Co., since it announced its $25-a-month plan for financing new V-eight Fords, has been doing the biggest business in its history.

While factories are hard at the task of making enough cars to satisfy dealers, Detroit is buzzing with preparations for 1937. Equipment orders are being placed rapidly. An outstanding program is that at the Chrysler Jefferson Avenue plant which calls for new tools for machining a six-cylinder engine for next year. Most of the machinery for the cylinder block line has been bought, purchases having been spread among several manufacturers. A large amount of machine tools are yet to be contracted for, including equipment for the camshaft, crankshaft and connecting rod departments. Altogether it is understood that expenditures may total $1,000,000.

Require Hypoid Gear Cutters

Chevrolet has allotted orders for gear cutting machinery, having given to one company releases for a battery of machines. Most of the tools are to be installed at the new transmission shop at Saginaw. The buying program at the local gear and axle plant also is under way. Hypoid gears appear to have taken the industry by storm for 1937. Their use in the rear end of next year's models will permit the lowering of the drive shaft and will eliminate the hump in the middle of the floors of some makes of cars. The fact that General Motors divisions are reported committed to them disposes of the story that there might be independent springing on rear wheels as well as front wheels in 1937. If independent springing were to be extended, hypoid gears would not be specified. Chrysler as well as General Motors is said to be going to hypoid gears next year.

It will be surprising if any company in the industry retains the fabric top after this year. Ford is understood to be planning on adopting the all-steel top. All Chrysler cars are expected to have steel tops. Hudson is said to have decided on going to a one-piece top which extends from the cowl in front, including the window framing, to the top of the trunk in the rear. Other companies are figuring on a similar design. The idea of a steel insert welded in the position formerly occupied by the fabric top is to be discarded. All of which points to the fact that an unprecedented amount of welding will be done on 1937 models.

Stamping presses are in active demand by the automobile industry. Briggs Mfg. Co. is spending around $500,000 for new large presses and Dodge Division of Chrysler is reported having contracted for a considerable number of new presses. Briggs is in the midst of a major die program.

Zephyr Has Set Style

At least one volume car maker is reliably reported to have decided to shift next year to the Lincoln-Zephyr type of frameless body. This will involve a radical change in its manufacturing facilities and its production executives already are worrying for fear that the changeover will take longer than the customary six weeks during which the plant normally is shut down and possibly may delay output of new models. However, it is only a matter of time until it appears that the whole industry will come around to the Zephyr design or a modification of it.

Early as it is in the year, almost all major parts contracts for 1937 have been signed.

Production officials from the General Motors plant in Australia are in Detroit for the purpose of buying die shop equipment. A commission from the Soviet also visited Detroit the past week, conferring with machine tool builders.

Although car manufacturers don't say much about it, mechanization is advancing by leaps and bounds. The industry finds that its materials costs can't be pushed down much lower than at present and wages too cannot be reduced. Hence the best way to pull down manufacturing expense is to spend money for high-production machinery which performs multiple operations and cuts down manpower.

Automotive labor is quiescent. There is slight danger of important trouble in the tool and die-making trade.

Production Control Chairman

JAMES M. TALBOT

Franco Studio.

Cites Need of Training

EVERARD STUBBS

Presides Over Cost Session

OSCAR GROTHE

A.M.A. Production Division Confers on Recovery Problems

CLEVELAND—Seven problems peculiar to business recovery were discussed at the conference of the Job Order and Mass Production Divisions of the American Management Association, held at the Hotel Statler, Cleveland, on April 16-17. Nearly 400 members and guests attended the sessions, a record high for this divisional activity. Credit for program arrangement is due O. D. Reich, vice-president, Dexter Folder Co., and Glenn Gardiner, Forstmann Woolen Co., AMA vice-presidents respectively of the two divisions.

Charles J. Stilwell, vice-president, the Warner & Swasey Co., presided at the annual dinner, held Thursday evening. Principal speaker was C. D. Barr, vice-president, American Cast Iron Pipe Co., who told of the Eagan Plan of Industrial Cooperation, under which his concern operates. Under the unique formula, established by the will of John J. Eagan in 1922, the common stock of ACIPCO is held in trust for the company's employees. A board of management, appointed by the directors, carries out the functions of the business is conjunction with a board of operatives elected by secret ballot.

Each of the seven discussion topics was presented by two men, and after each, the floor was thrown open for general discussion. Subjects were:

Rebuilding the Working Force

C. J. Freund, dean, College of Engineering University of Detroit, described the community enterprise started last year by Detroit industries to train young men. Details of this program were in these pages at the time of its inauguration (*AM*—Vol. 79, page 823).

Training from the standpoint of the individual concerns was presented by Everard Stubbs, factory manager, the Fellows Gear Shaper Co. Mr. Stubbs brought out that management usually failed to realize the high percentage of skilled men who have received but little formal training.

Revamping Equipment and Layout

A review of methods is an essential prelude to any plan of equipment arrangement according to F. J. Van Poppelen, industrial engineer, Remington Arms Co. He described the practice of his concern in analyzing every operation on a part before taking up the question of material handling and metal-working equipment.

Ralph F. Cohn, factory manager, Reynolds Wire Co., said that he required equipment to save 20 per cent of its cost annually before he would buy it. Mr. Cohn expressed a preference for small productive units as against large ones because of the greater flexibility they afforded.

Restoring Effective Production Control

Speaking of production control as it affects manufacturing for inventory to go to retail outlets, James P. Margeson, Jr., assistant general manager, Manufacturing Division, Marshall Field & Co., outlined a method by which production is scheduled according to sales forecasts. A feature of the plan is its flexibility, a monthly rivision being used to control 26 factories and mills.

H. B. Maynard, president, Methods Engineering Council, Inc., emphasized the importance of breaking down operations into time elements in order to plan intelligently. He spoke of the need of taking into account such factors as rush service jobs, absences, breakdowns, and repairs so that the schedule set up can be met.

Rekindling Incentives

An incentive plan must have as its objective a reduction in cost accompanied by increased earnings to the worker according to I. H. Freeman, supervisor of industrial relations, General Electric Co., Fort Wayne, Ind. Mr. Freeman also stressed the importance of job evaluation regardless of the type of incentive plan in effect.

A. H. Mogensen, industrial consultant and consulting editor, *Factory Management and Maintenance*, stated that failure to produce results by some incentive plans was caused by neglect of the worker's viewpoint in a matter which vitally concerned him. By means of a moving picture film, he demonstrated his plan of enlisting the interest of foremen and supervisors in efficient methods through motion study.

Revitalizing the Supervisory Force

The G. M. Executive Training Program was described by Major Albert Sobey, director, General Motors Institute. Major Sobey told how horizontal groups are organized into conferences with the master session determining the trend of discussion.

How his concern was able to embark in a new price field by enlisting the cooperation of its supervisory group was included in a talk by Winthrop

P. Stevens, factory assistant superintendent, F. C. Huyck & Sons. Mr. Stevens stated that financial incentives were an important part of this undertaking.

Intensifying Quality Control

J. Carlton Ward, assistant general manager, Pratt & Whitney Aircraft Co., told of some of the exacting details which must be met to build a motor which would run 90,000 miles between overhauls. This, he said, could only be done by refusing to tolerate any departure from the strict quality standards set up by the engineering department.

Quite another angle of quality control was brought out by E. A. Hassett, personnel supervisor, Du Pont Cellophane Co. Mr. Hassett spoke on a series of contests conducted for Du Pont employees, expressly to develop quality consciousness.

Keeping a Tight Rein on Costs

Past costs are no longer a good means for determining relative efficiency of current operations, Frank Klein, director of budgets, Worthington Pump & Machinery Corporation, said in his address. He urged simplified control through a carefully planned budget to place responsibility for needless expense.

R. A. McCarty, Westinghouse Electric & Mfg. Co., described how his company had decentralized responsibility for operating costs. He, too, stated a firm belief in budgets but advocated they be made flexible.

To sum up the two-day sessions, the conference concluded with a panel discussion under the chairmanship of Russell J. Greenly, associate professor, University of Akron. Other members of the panel were C. S. Cragmile, vice-president, Belden Mfg. Co., Glenn Gardiner, Oscar Grothe, vice-president, White Sewing Machine Co., Raymond S. Perry, vice-president, Ingersoll Milling Machine Co., R. F. Whisler, manager, Standards Department, National Cash Register Co., R. H. Rositzke, R. H. Rositzke & Associates, and Erwin H. Schell, professor of business management, Massachusetts Institute of Technology.

Industrial Review

• STIMULATED by a few flood replacements, a certain amount of automobile business and one price increase, machine tool sales were better in April. Machinery distributors have adopted the wise policy of booking every order possible while business is on the upgrade, and despite the political threats to business inherent in the President's tax program and forecast in his Baltimore speech.

• IN THE NEW ENGLAND territory, orders and inquiries continue to come in in satisfactory volume and distributors are optimistic for continued good business for several months. The Metropolitan district, according to New York distributors, has experienced an improvement in actual orders that may bring the month of April almost into the 1929 class. In Philadelphia there has been a slight recession partly because deliveries are more difficult to get, but the undercurrent of sentiment is felt to be decidedly hopeful. Pittsburgh reports that flood damage to industrial equipment was apparently much more serious than had been thought at first. Both machine tool and small tool business in this territory are working toward higher levels. No immediate threat of labor trouble exists anywhere in the Eastern territory.

• IN CLEVELAND, wage rates are tending upward, but the pressure of the skilled labor shortage is easing as a result of the many training programs that have now been operating for some months. Detroit automobile manufacturers are beginning to talk about machine tool purchases, one having gone so far as to mention a "program." Orders and inquiries for machine tools are indicative of an improvement in business and a considerable increase in small tool orders is imminent. In Cincinnati improvemet in the machine tool industry is reported by most observers although there are instances of slight recession in April.

• THINGS ARE MOVING ALONG on a fair level in Indiana, with inquiries and orders from diversified lines at a level which could fairly be considered normal. There is apparently very little labor unrest. In and around St. Louis, machinery orders are rather quiet but inquiry is active and supply sales are in excellent volume. Spotty conditions prevail in Chicago and surrounding cities, some distributors reporting a decrease from the March level, others the best business since 1930. Inquiries are excellent and there is no labor trouble in sight now. Much the same thing can be said of the Milwaukee district where business is holding up fairly well, especially in smaller tools. Serious labor troubles do not exist for the moment.

Manufacturers Hiring Big Share of Workers

M.A.P.I. Publishes Factual Study of Ratios of Employment

Manufacturing industries have furnished sixteen times their share of new jobs in the last two years, the Machinery & Allied Products Institute announced in a pamphlet "More Facts on Technology and Employment."

Although manufacturing industries are only one-fourth as large as all other occupations, measured by total wage earners, they have added four times as many workers to their payrolls in the last two years as all other occupations combined," the survey says. Data were based on studies made by the National Industrial Conference Board.

The Institute pointed out that employment in manufacturing and mechanical industries today is more than 3,000,000 in excess of the number for 1900, and that between 1900 and 1930 factory employment increased 88 per cent, while employment in all occupations increased only 60 per cent.

Only one-fifth of all wage earners ever are employed in manufacturing, and the proportion today is as high as it was in 1929, John W. O'Leary, president of the institute, said.

BOEING EXPANDS PLANT

Purchase of a 28-acre site for expanding the factory of the Boeing Aircraft Co., at Boeing Field, Seattle, Wash., has been announced. A large building is being contracted for, and other additions will be made as increased production may require.

TO BUILD 26 BIG ENGINES

Production on 26 aircraft engines, rated at 1,000 hp., but capable of delivering 1,150 hp., will begin soon at the Pratt & Whitney Air craft plant. The engines are said to be the most powerful radial aircooled powerplants in existance, and will power 10 new Douglas transport planes being built for the United Airlines.

Watching Washington

Congress session approaches the closing dead line . . . Prospects poor for pending bills except taxes and relief . . . Nye Committee castigates munition companies, majority for nationalization of plants

WASHINGTON — The inexorable approach of the political convention is narrowing the activities of Congress to efforts to pass a tax bill and a relief measure. Generally speaking this situation may be counted as favorable for the country because, of the bills, pending, there are more unfavorable than favorable ones from industry's point of view.

Hearings on the tax bill, as conducted by the Ways and Means committee, were little more than a farce, in the opinion of persons who have followed tax legislation for many years.

Few disinterested experts testified. Students of taxation were unwilling to testify because the proposals had not been reduced to specific terms. Members of the committee, regardless of party, were principally interested in making a record that could be used in the campaign.

Talking to Voters

Even the witnesses of the Chamber of Commerce and of the Association of Manufacturer's were talking to the country, not to the committee. These latter witnesses were attempting to raise so much doubt about the bill in the public mind that changes would be made possible in the Senate.

It becomes increasingly apparent that the Senate will write the tax bill and that it will be a different measure from the one that has been discussed by House committees. The reason is that the House bill does not meet either the President's ideas of social reform or the Treasury's ideas of the money needed.

Congress is doing some thinking of its own on the relief problem. There is very general recognition that radical changes must be made in existing policies. There are areas where the advent of new plants has created more employment than existed in 1929 yet there is as large a percentage of the population on relief as anywhere else.

There is complete agreement that provision must be made to supply the necessities of life to those who cannot or will not work. The thought is being resurrected that these necessities of life should be furnished by the federal government only to those who will take up residence in a camp or other institution. Provision would be made for manual training and education along other lines. There would be an allowance going to dependents or provisions would be made to give the entire family the educational and other advantages of the institution.

Many would make renewed efforts to support themselves rather than secure relief under such conditions while those who could not would be assured of the necessities of life and an opportunity for training that would make the finding of a job less difficult.

A strong fight has developed to give Secretary Ickes $700,000,000 of the proposed billion and a half for relief instead of leaving it to the tender mercies of Mr. Hopkins. Some sort of a relief bill will have to be passed, of course, and the chances are that the President will be allowed to spend a billion and a half of new money plus more than a billion left over from previous appropriations to take care of relief needs, political and otherwise, during the balance of his term. [See the editorial on page 344a for our point of view on relief.]

Many Bills Will Fail

There is a chance that a price discrimination bill will get through and there may be an anti-lobbying bill, but there is very little chance for Federal licensing, the 30-hour week, the Healey measure (revised Walsh bill), the Ellenbogen little NIRA bill for the textile industry, the ship subsidy bill, the housing bill or the Mississippi Valley Authority. Many of these bills will come up again in the next session of Congress.

As of April 1 the National Labor Relations Board reports that it has acted in 729 cases involving 165,000 workers.

Mr. Nye's special committee on investigation of the munitions industry has submitted a report which reads like a Richard Harding Davis South American revolution story or an Oppenheim novel of international intrigue. Whether you agree with the findings of the committee majority or not you will have to admit that whoever put the final touches on the report knew how to write an interesting story. For instance "it will remain for commissions with full powers in the large European nations to report on the provocative activities of their companies, particularly to investigate the statements made in the French Chamber of Deputies, that Skoda in Czechoslovakia, a subsidiary of Schneider-Creusot, financed the Hitler movement to power, which, more than any one other event, can be credited with causing the present huge rearmament race in Europe, so profitable to the European steel, airplane, and munitions companies."

Divided on Recommendations

The committee was unanimous that a lot of very unethical things have been done by all of the American companies engaged in the manufacture of munitions as a major operation or as a side issue, but it divided when it reached the point of making recommendations. The majority comes out flatly for government ownership and operation of "facilities adequate for the construction of all warships, by the United States Navy Department, also all gun forgings, projectiles, and armor plate, and of facilities adequate for the production of powder, rifles, pistols, and machine guns necessary for the United States War Department."

The minority "questions the complete nationalization of certain defense commodities, because it doubts the advantage from the standpoint of (1) its effect upon disarmament, (2) its effect upon essential national defense, and (3) its effect upon Government costs. . . . . In other words, the committee minority believes that the public welfare, from the standpoint of peace, defense, and economy, can be better served by rigid and conclusive munitions control than by nationalization except in a few isolated instances."

ENGINEERS ORGANIZE

Detroit Group Is Representative of All Engineering Interests

The Engineering Society of Detroit, an educational and scientific group, was organized recently by a group of engineers including John H. Hunt, General Motors Corp.; James W. Parker, vice-president, Detroit Edison Co.; W. D. Cameron, Detroit manager, General Electric Co.; Clyde R. Paton, chief engineer, Packard Motor Car Co.; Harold S. Ellington, construction engineer; Clair W. Ditchy, architect; and David Segal, Eberbach & Son., Inc.; and E. J. Burdick, financier. The above comprise the board of directors.

It is expected that the group will be financed in their work by funds from the Horace and Mary H. Rackham foundation.

BUYING MORE TOOLS

Mexico Importation of Machinery Gains, Reached $41,469,230 in 1935

Mexico is buying more industrial and agricultural machinery from U. S. and other foreign makers, a report of the Ministry of National Economy, Mexico City, D.F., shows. Last year Mexicans imported $41,469,230 worth of machinery, or about a third of the total imports, and about $10,000,000 more machinery than was bought from foreign sources the year before.

TRUCK COMPANIES MERGE

Continental-DiVco Co. and the delivery division of Twin Coach Co., motor truck manufacturers, have been merged under the name of DiVco-Twin Truck Co., with F. R. Fageol chairman, and John Nichol president.

On the Air

HERMAN H. LIND

Men and machines was discussed on a program of the National Broadcasting Co., Thursday, April 16, by HERMAN H. LIND, general manager, National Machine Tool Builders' Association, under the auspices of America's Town Meeting. The program was from 9:30 to 10:30, and included RALPH BORSODI, president, Borsodi Analytical Bureau, and Prof. WALTER RAUTENSTRAUCH, Columbia University.

PAYROLLS UP 23%

Automotive Parts Industry Shows 17% Gain in January Employment

The 333 member companies of the Automotive Parts & Equipment Manufacturers, Inc., showed the automotive parts industry employed 17.2 per cent more workers in January, 1936, than during the same month last year. Payrolls were 23.1 greater this January than last, although man-hours worked were only 17.9 per cent greater than during January, 1935.

Two-Year Job Increase Estimated At 5,413,000

Work Solution Does Not Rest on Manufacturers Alone

An increase of 5,413,000 in the number of persons employed in the United States between March, 1933, and December, 1935, was reported by the National Industrial Conference Board. This increase, however, has not contributed materially to solving the relief problem, the board pointed out.

"The solution of unemployment must be sought chiefly by an increased activity in fields other than manufacture," the board said, pointing out that the manufacturing industries had given employment to about 8,892,000 persons in January, 1936, or 400,000 more than in January, 1935, and nearly 1,000,000 more than in January, 1934.

"It has been able to do this because of an increased demand for manufactured products, particularly those in the durable goods industries." Further increases depend on increased demands for goods, rather than upon manufacturing executives, it said.

The board pointed out that during January of this year labor cost per man-hour is manufacturing was 9 per cent above the 1929 level.

EXPANDS RADIO OUTPUT

General Motors Corp. Buys Crosley Radio Kokomo, Ind., Plant

General Motors Corp. has bought the Kokomo, Ind., division of Crosley Radio Corp., and will operate it as a subsidiary of Delco-Remy. The new division will be known as Delco Radio, and will manufacture radio set for General Motors cars. The corporation will continue to purchase a considerable portion of its radio requirements from outside manufacturers, however, Alfred P. Sloan, Jr., president of the parent company said. Ray C. Ellis, formerly of the engineering staff of General Motors, will be general manager.

The trend of the automobile radio industry is shown, unofficially, by the following estimates made by *The Wall Street Journal:*

	No. sets	List price
1935	1,100,000	$53,350,000
1934	780,000	32,500,000
1933	724,000	28,598,000
1932	143,000	7,150,000
1931	108,000	5,940,000
1930	34,000	3,000,000

For 1936 a further substantial increase is anticipated, in line with increased automobile production.

All cars manufactured in this country are wired for radio.

Table I—Index of Orders

Based on Volume of Shipments for 1926

Month	Index of Orders: Domestic	Foreign	Total	3 Months' Average Index	% Foreign to Total Orders
1935—May	57.3	16.0	73.3	67.1	21
June	75.5	15.6	91.1	76.7	17
July	82.5	37.3	119.8	94.7	31
August	78.2	47.6	125.8	112.2	37
September	54.1	25.9	80.0	108.5	32
October	79.5	23.4	102.9	102.9	23
November	79.2	19.4	98.6	93.8	19
December	78.1	20.2	98.3	99.9	21
1936—January	95.7	15.1	110.8	102.6	14
February	99.8	12.3	112.1	107.1	11
March	89.0	16.3	105.3	109.4	15

Table II—Distribution of Orders

Average Indexes of Individual Companies	Companies in Per Cent of Total Number Reporting: 1935, by Quarters: 1st	2nd	3rd	4th	1936: 1st
200-up	4.2	5.8	14.2	11.3	13.0
100–199	12.5	15.8	22.1	24.3	24.6
60–99	16.9	22.0	17.2	21.7	22.4
20–59	39.6	31.2	31.6	27.7	26.5
Less than 20%	26.8	25.2	14.9	15.0	13.5
	100.0	100.0	100.0	100.0	100.0

PERSONALS

L. E. ALLARD has become assistant master mechanic of the Missouri Pacific's Kansas City terminal division, succeeding R. H. Tait, retired.

W. HOWARD EDWARDS has resigned as manager of Studebaker Export Corp. truck division, to devote his entire time to Edwards Iron Works, South Bend, Ind., of which he is president.

W. E. HAWKINSON has been elected treasurer of Allis-Chalmers Mfg. Co., Milwaukee, Wis., succeeding the late RAYMOND DILL.

FRED F. HICKEY, general manager of Savage Arms Co., Ithaca, N. Y., has been elected a director of the company, replacing R. Stuyvesant Pierrepont.

R. C. INGERSOLL, president of Ingersoll Steel & Disc Division of Borg-Warner Corp., Chicago, Ill., was elected a director of the parent company.

S. T. KUHN has been appointed assistant master mechanic of the New York Central's Collinwood shops, Cleveland, Ohio.

W. A. ROYERSTON, Oil City, Pa., was elected president of Mullins Boat Co., Oil City, Pa., manufacturers of pressed steel boats and other metal products.

Sees Engineering Unity

WILLIAM L. BATT

A testimonial presentation was made April 21 to Eric Oberg, editor of *Machinery*, for ten years treasurer of the American Society of Mechanical Engineers by Roy V. Wright, past president, and managing editor of *Railway Age*. William L. Batt, president of the A.S.M.E., and head of S.K.F. Industries, Inc., Philadelphia, Pa., spoke on "Unity of the Profession," another feature of the President's Night program of the Metropolitan Section, New York.

FRANK W. WELLS, export division, Chrysler Corp., has been appointed production manager.

Expands Again—A part of the new 20,000 sq. ft. wing of the Michigan Tool Co. plant, 7171 East McNichols Rd., Detroit, which will be devoted to manufacturing special machinery. This is the second expansion of the company during the past five years

BECOMES PROFESSOR

John M. Lessells, Consulting Engineer, Joins M. I. T. Faculty

JOHN M. LESSELLS, consulting mechanical engineer, Swarthmore, Pa., has been appointed associate professor of mechanical engineering, Massachusetts Institute of Technology. His teaching and research work will be confined to engineering materials. He is editor of the "Journal of Applied Mechanics," published by the American Society of Mechanical Engineers, and in 1926 was awarded the Bernard Hall prize by the Institution of Mechanical Engineers, Great Britain, for a paper on fatigue and elastic limit. Born in Scotland, he was graduated from Glasgow University. He was with Westinghouse Electric & Mfg. Co. for several years.

JOINS CRANE CO.

G. L. Erwin, Jr., Formerly With Kearney & Trecker, to Study Markets

GEORGE L. ERWIN, JR., former sales manager of the Kearney & Trecker Corp., Milwaukee, Wis., has been appointed assistant to the vice-president in charge of sales of the Crane Co., Chicago, Ill., manufacturers of valves, fittings and heating and plumbing material. Besides the normal duties of such a position, Mr. Erwin's work will consist of analyzing products, markets and merchandising problems.

J. F. MURPHY PROMOTED

JOHN F. MURPHY has been appointed superintendent of shops, Boston & Albany Railroad, succeeding JOHN H. MINETTE, deceased. He had been assistant general foreman of the railroad's locomotive shops, West Springfield, Mass., where he became machine shop foreman in 1912. He has always been an active supporter of apprentice training.

G. L. MILLER TO DO RESEARCH

GEORGE LEE MILLER, vice-president and works manager of the Diebold Safe & Lock Co., Canton, Ohio, resigned on April 1. He plans to devote his time to research on bullet-proof steel.

PURCHASING AGENTS ELECT

GEORGE A. NEESHAM, assistant treasurer and purchasing agent of Wykoff Drawn Steel Co., Chicago, Ill., has been elected vice-president of district No. 3, National Association of Purchasing Agents. He is president of the Chicago branch of the Association, and instructor of purchasing, DePaul University.

BUSINESS ITEMS

Carl Schenck, G.M.B.H., Darmstadt, Germany, has appointed R. Y. Ferner Co., 161 Devonshire St., Boston, Mass., exclusive representatives in the United States and Canada for its line of material testing equipment and dynamic and static balancing devices.

Mullins Mfg. Co., Salem, Ohio, has acquired the plant of the Kramer Auto Body Co., Oil City, Pa., for the factory of its new subsidiary, Mullins Boat Corp., pressed steel boat builders.

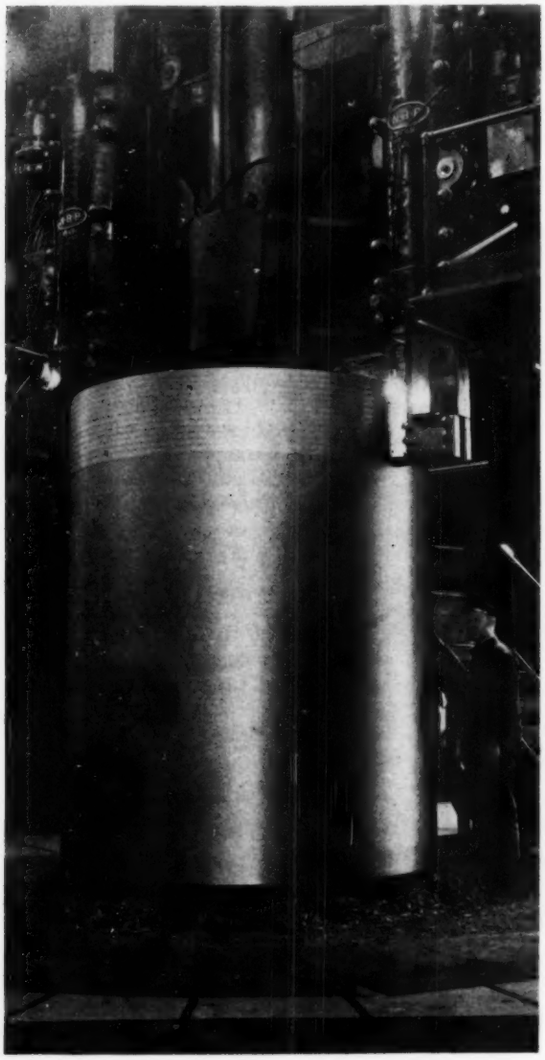
New Departure Mfg. Co., New Britain, Conn., has moved its Chicago office from the Peoples Gas Bldg., to the Carbide & Carbon Bldg.

Ingersoll Milling Machine Co., Rockford, Ill., has appointed William G. Harvey Co., 2222 South Geddes St., Syracuse, N. Y., its sales agent in the Upper New York state area.

Temperature Research Foundation, 80 Broadway, New York, N. Y., has been established by the Kelvinator Corp., Detroit, Mich. Edward Heitman, chief engineer of the company will be director of the foundation, George W. Mason, president, announced. The organization "will operate in the interest of the public welfare . . . and to serve as a clearing house for information on all phases of temperature research," the announcement said.

De Vlieg Milling Machine Co. has moved from Jackson, Mich., to the Curtis Bldg., Detroit, Mich. It will build the products of Reed-Prentice Corp., Worcester, Mass., Charles De Vlieg, president, said.

Clearing Machine Corp., power press manufacturers, will enlarge its plant at 6499 West 65th St., Clearing, Ill., W. R. Glasner, president, announced in reporting steady increases in business during the past two years.



To Dry Paper — Nickel cast-iron cylinder, 10 ft. long and 8 ft. in diameter, being machined in the Allis-Chalmers plant for a paper manufacturer. The shell is 2 in. thick and weighs 30,000 lb., and was cast in the Allis-Chalmers foundry. It will serve as a drier on the paper machine. Machining consisted of rough turning and boring, flash cut on the exterior, both ends turned for specially fitted cast-iron heads, also furnished by the company. It will be finish ground by the customer

Carboloy Co., Inc., 2985 East Jefferson Ave., Detroit, Mich., has transferred A. F. Dobbrodt, formerly of its Chicago office, to Milwaukee, Wis., with offices at 2802 Atkinson Ave. He will represent the company in Wisconsin.

Hoover Ball & Bearing Co. is the new name of the Hoover Steel Ball Co., Ann Arbor, Mich.

OBITUARIES

EDWARD W. ARMS, 90, inventor and designer of precision instruments and the oldest living graduate of Rensselaer Polytechnic Institute, died March 31 in Troy, N. Y. For more than 60 years he was connected with W. & L. E. Gurley, Troy, manufacturers of engineers' instruments and for many years was chief engineer. A civil and mechanical engineer, he designed both instruments and special machinery for their manufacture.

CHARLES A. BERTSCH, 84, president and founder of Bertsch & Co., sheet metal working machinery manufacturers, Cambridge City, Ind., died March 30.

ALONZO R. CLARKSON, 91, for 40 years president of Niagara Screw Co., Buffalo, N. Y., died March 13 in Rochester, N. Y.

WALTER L. FAY, 77, founder of Fay & Bowen Engine Co., Geneva, N. Y., died March 28.

FRED E. GRITZENDANNER, 53, a partner in the Greenwich Machine & Tool Co., New York, N. Y., died April 8 in East Orange, N. J.

HARRY U. HART, vice-president and chief engineer of the Canadian Westinghouse Co., Ltd., died March 15 at Hamilton, Ont.

DAVID J. HURLEY, 61, president of D. J. Hurley & Sons, steel forgers and machinists, Newark, N. J., died April 9. He organized his firm about 40 years ago.

JOSEPH DENNY SARGENT, 75, for many years an official of the Sargent Hardware Co., New Haven, Conn., died April 8 in Hurley, N. Y.

NORMAN W. WARREN, former vice-president and general manager of the Dominion Bridge Co., Ltd., Montreal, Canada, and vice-president of Canadian Tillsoil Farm Motors, died April 4 in his Berlin, Conn., home.

SAMUEL STOCKTON WHITE, JR., 81, for 60 years an executive of the S. S. White Dental Mfg. Co., Philadelphia, Pa., died April 15. He was formerly president of the company.

Corporation Reports

Company	1935 Earnings	1934 Earnings
Advance Rumely Corp.	d$43,098	d$41,307
Aero Supply Mfg. Co.	20,870	d50,910
Allied Products Corp.	238,714	.....
Art Metal Works, Inc.	308,886	200,938
Automatic Products Corp.	36,050	37,537
Automatic Signal Corp. (6 mos. ended Dec. 31)	9,902	.....
Bower Roller Bearing Co.	838,502	615,771
Centrifugal Pipe Corp.	336,193	.....
City Auto Stamping Co.	474,153	66,892
Coleman Lamp & Stove Co.	314,496	227,626
Continental Motors Corp.	d48,003	.....
Dresser (S. R.) Mfg. Co. (3 mos. ended March 31)	d43,985	.....
Eastern Steel Products, Ltd.	d1,521	d1,535
Eastman Kodak Co.	15,913,251	14,503,247
Easy Washing Machine Corp.	284,712	d18,247
Eisman Magneto Corp.	25,458	d37,349
Electric Products Corp.	65,944	42,595
Essex Co.	40,394	27,311
Fairchild Aviation Corp.	d98,868	d65,002
Federal Motor Truck Co.	144,296	36,062
Ford Motor Co. of Canada, Ltd.	1,939,204	1,878 113
General Time Instruments Corp.	852,000	685,051
Hamilton Watch Co.	536,878	289,461
Hayes Wheels & Forgings, Ltd.	d38,331	d10,660
Independent Pneumatic Tool Co.	879,667	672,280
International Button-Hole Sewing Machine Co.	176,234	158,600
Johnson Motor Co.	d38,653	44,079
Keystone Steel & Wire Co. (6 mos. ended Dec. 31)	717,137	.....
Mullins Mfg. Corp.	$474,605	$251,058
New Britain Machine Co. & New Britain-Gridley Machine Co.	91,546	7,200
Northwest Engineering Co.	414,115	21,612
Oliver Farm Equipment Co.	d482,005	d7,383,896
Parker Rust Proof Co. (Quarter ended March 31)	250,393	273,850
Perfect Circle Co.	239,655	549,762
Pittsburgh Forgings Co.	57,864	31,040
Poor & Co.	127,410	296,664
Reece Button-Hole Machine Co.	122,083	149,955
Ruud Mfg. Co.	33,573	d33,091
Standard Screw Co.	546,667	319,295
Standard Steel Spring Co.	135,711	110,791
Timken Axle Co.	1,173,202	426,125
Transue & Williams Steel Forging Corp. (Quarter ended March 31)	33,515	54,623
Twin Coach Co. (Quarter ended March 31)	100,053	.....
Underwood Elliott-Fisher Co. (Quarter ended March 31)	828,661	719,043
United States Radiator Corp.	d394,895	d464,481
Walker Mfg. Co.	102,151	162,475
West Michigan Steel Foundry Co.	123,409	78,255
White (S. S.) Dental Mfg. Co.	215,725	287,681
Wright Aeronautical Corp.	423,295	966,153
Young (A. L.) Spring & Wire Co.	1,816,108	881,483

d, deficit.

MEETINGS

AIR CONDITIONING MFRS. ASSOCIATION. Annual Meeting, May 16, Hot Springs, Va.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Annual Meeting & Exposition, May 4-9, Detroit, Mich. C. E. Hoyt, Secretary, 222 West Adams St., Chicago, Ill.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Summer Meeting, June 15-20, Dallas, Texas. C. E. Davies, Secretary, 29 West 39th St., New York, N. Y.

REFRIGERATING MACHINERY ASSOCIATION. Convention, May 14-16, Hot Springs, Va. William B. Henderson, Secretary, 915 Southern Bldg., Washington, D. C.

SCIENTIFIC APPARATUS MAKERS OF AMERICA. Annual Meeting, June 1-3, Edgewater Beach Hotel, Chicago, Ill. J. M. Roberts, Secretary, 20 North Wacker Dr., Chicago, Ill.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. Summer Meeting, May 31-June 6, White Sulphur Springs, W. Va. John A. C. Warner, Secretary-General Manager, 29 West 39th Street, New York, N. Y.

U. S. CHAMBER OF COMMERCE. Annual Meeting, April 27-30, Washington, D. C.

PATENTS

March 10, 1936

Processes

Process of Making a Metal Article of Precise Dimensions and the Article Produced Thereby. Henry A. De Fries, Cleveland, Ohio, assigned to The Nitralloy Corp. Patent 2,033,927.

Process of Stamping Blanks. Charles R. Moon, Muncie, Ind., assigned to Ontario Manufacturing Co. Patent 2,033,993.

Process of Making Twist Drills. George D. Hayden and Howard A. Hayden, Detroit, Mich., assigned to Ace Drill Co. Patent 2,034,514.

Process and Apparatus for Assembling and Fitting the Elements of Needle or Roller Bearings. Alfred Otto Pitner, Paris, France. Patent 2,034,534.

March 24, 1936

Metal-Working Machinery

Gear Shaping Machine. Edward W. Miller, Springfield, Vt., assigned to The Fellows Gear Shaper Co. Patent 2,034,765.

Rolling Mill Screwdown. Florence G. Biggert, Jr., Crafton, Pa., assigned to United Engineering & Foundry Co. Patent 2,034,939.

Cylindrical Surface Turning Machine. Edward P. Bullard, Fairfield, Conn., assigned to the Bullard Co. Patent 2,035,043.

Indicating Device for Use in Connection with Grinding Tools. Viktor Fölsche, Velten, near Berlin, Germany. Patent 2,035,119.

Machine Tool. Clement J. Schroeder, Rockford, Ill., assigned to Sundstrand Machine Tool Co. Patent 2,035,283.

Stock Feeding and Gripping Device. John J. N. Van Hamersveld, Cleveland Heights, Ohio, assigned to the Warner & Swasey Co. Patent 2,035,354.

Transmission and Control Mechanism for Machine Tools. Edward J. Kearney, Wauwatosa, Wis., assigned to Kearney & Tecker Corp. Patent 2,035,388.

Gear Shaping Machine. Julian S. Loewus, Baltimore, Md. Patent 2,035,434.

Tools and Attachments

Gage Holder. Frederick H. Markwick, Dayton, Ohio, assigned to Sheffield Gage Corp. Patent 2,035,082.

Tool Holder and Guide. Karl W. Holmberg, Cleveland, Ohio, assigned to Weldon Tool Co. Patent 2,035,163.

Surface Smoothness Indicator. Harry M. Bramberry, Newcastle, Ind., assigned to the Perfect Circle Co. Patent 2,035,220.

Tapping Attachment. George W. Emrick, Brooklyn, N. Y. Patent 2,035,224.

Thread Cutting Tool. Waynard R. Vosper, Toledo, Ohio, assigned to The Toledo Pipe Threading Machine Co. Patent 2,035,285.

Processes

Grinding Wheel and Method of Making the Same. Wallace L. Howe, Boylston, Mass., assigned to Norton Co. Patent 2,034,721.

Manufacture of Lightweight Cylinders or Containers. Anton Rothschmitt, Irvington, N. J., assigned to Walter Kidde & Co., Inc. Patent 2,035,408.

March 31, 1936

Metal-Working Machinery

Apparatus for Cutting Sheet Metal or the Like. Nils Fredrik Filemon Andersson, Kappala, Lidingo, Sweden. Patent 2,035,448.

Traversing Mechanism for Turrets. Harold W. Evans, Wilkes-Barre, Pa. Patent 2,035,466.

Grinding of Rotative Eccentric Knives. Walter Everett Molins, Felix Frederic Ruau, and Frederick William Hacking, Deptford, London, England. Patent 2,035,563.

Plating Machine. John C. Bogle, Grosse Pointe Village, Mich., assigned to Udylite Co. Patent 2,035,633.

Machine for Forming Threads on Metal Tubing. Theodore Briegel, Moline, Ill. Patent 2,035,687.

Pneumatic Hammer Testing Machine. Tatsumi Takahashi, Higashi-ku, Osaka, Japan. Patent 2,035,729.

Grinding Machine. George W. Binns and Lincoln E. Mehlhope, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 2,035,737.

Autogenous Welding and Cutting Machine. Adam Schmidt, Vienna, Austria. Patent 2,035,765.

Control for Die Casting Machines for Plastic Masses. Hans Gastrow, Zerbst in Anhalt, Germany. Patent 2,035,801.

Heat-Treating Machine. Lawrence Jacobsmeyer, Chicago, Ill. Patent 2,035,890.

Feed Finger for Screw Machines and the Like. Earl W. Brinkman, Rochester, N. Y., assigned to Davenport Machine Tool Co., Inc. Patent 2,035,942.

Machine Tool Unit. Ernest J. Svenson, Rockford, Ill., assigned to W. F. & John Barnes Co. Patent 2,036,162.

Tools and Attachments

Comparator. Robert O. Beardsley, Ernest T. Bysshe, and Robert R. Finn, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 2,035,780.

Milling Attachment. Alfred Hofmann, Palisade, N. J., assigned to Alfred Hofmann Needle Works, Inc. Patent 2,035,810.

Tool Holder. Thomas B. Tiefenbacher, Paterson, N. J. Patent 2,035,999.

Processes

Resistance Welding. John C. Granfield and Jacob J. Vienneau, Pittsfield, Mass., assigned to General Electric Co. Patent 2,036,041.

April 7, 1936

Metal-Working Machinery

Machine Tool. Hans Ernst, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 2,036,206.

Welding Apparatus. Rollo B. Lincoln and Albert M. Candy, Wilkinsburg, Pa., assigned to Westinghouse Electric & Manufacturing Co. Patent 2,036,224.

Work Support. Fred R. Swanson, Rockford, Ill., assigned to Sundstrand Machine Tool Co. Patent 2,036,240.

Trimmer. John J. Taylor, Barberton, Ohio, assigned to the Ohio Brass Co. Patent 2,036,241.

Gear Lapping Machine. Herbert J. Wills, Niagara Falls, N. Y., assigned to the Carborundum Co. Patent 2,036,246.

Metal Working Machine. Myron S. Curtis, Pawtucket, R. I., assigned to William Wallace Potter. Patent 2,036,260.

Machine Requirements and Industrial Construction

EQUIPMENT WANTED

Ill., Chicago—Department of Public Works, O. E. Hewitt, Comr.—12 or 13 in. by 5 ft. engine lathe, single back geared, 4 cone steps, quick change gear mechanism.

Ind., Muncie—Owens-Illinois Glass Co., 9th St. at Macedonia Ave.—machinery for the manufacture of glass blocks, also for machine shop.

Mass., Norfolk — Commonwealth of Massachusetts, Supt. of Prison Colony, will receive bids until Apr. 30 for shop equipment and food canning equipment.

Mass., Reading—O. W. Packer, 38 Forest St. —small lathe, drill press, saw table, motor driven; also machinist's tools.

Mass., Springfield—Col. T. J. Smith, Commanding Officer, Springfield Armory, will receive bids until May 4 for special machine rod, wood, also overhauling and motorizing lathe.

N. Y., Arcade—K. R. Wilson Foundry Co., 10 Lock St., Buffalo—complete machinery for the manufacture of garage equipment.

N. Y., Binghamton—Binghamton Foundry & Machine Co., W. Bloomer, Floral Ave.—beam punch for new structural steel fabricating division.

N. Y., Homer—Newton Woolen Mills, Van Miller, Pres. and Mgr.—complete machinery and equipment for woolen mill including transmission and conveying equipment, to replace that recently destroyed by fire.

N. Y., Marcellus—B. A. Brown—power saw.

Pa., Fawn Grove—Fawn Grove Mfg. Co.—industrial sewing machines and other machinery to replace equipment recently destroyed by fire.

Pa., Grove City—Pine Township Coal Co.—transmission and conveying machinery, boilers, engine, etc., to replace equipment destroyed by fire.

Pa., Montoursville—Board of Education, G. C. Lyter, Supervising Principal—woodworking and metalworking machinery and equipment for vocational department in high school.

Pa., Morris—H. H. Repperd—motor driven planing machine.

Pa., Pottstown—Pottstown Borough School Board, F. M. Haiston, Supt., will soon take bids for woodworking and metalworking machinery and equipment for installation in vocational school building now under construction.

Pa., West Lawn—Spring Township School Board will take bids early in May for complete equipment for vocational division to be installed in addition to Wilson High School, including metalworking, woodworking and electric shops.

Pa., West York—John H. Myers & Son—woodworking machinery and equipment for planing mill, including planer, jointer, tenaner, saws and transmission and conveying equipment.

Pa., Williamsport—W. D. Crooks & Sons, W. D. Crooks, Jr., Mgr., foot of Park St.—24 or 30 in. edging machine for manufacture of veneered doors.

Alta., Edmonton — Western Co., 10213 97th St.—complete oxy-acetylene welding and cutting outfit.

Man., Winnipeg—J. Biggerstaff, 621 Greenwood St.—one 5½ or 6½ in. South Bend lathe, drilling machine, 12 or 14 in. shaper.

N. B., Gagetown—Reid Brothers, Ltd.—modern shingle machine. State make and price.

Ont., Goward—Cuniptau Mines, Ltd., G. M. Lee, Engr.—gravity jig concentrator, 2,000 tons per day.

OPPORTUNITIES FOR FUTURE BUSINESS

Calif., Los Angeles—Federated Metals Corp., 2425 Hunter St., has awarded the contract for two factory buildings at East 26th St. and Indiana Ave. Estimated cost $100,000. Noted Feb. 12.

Calif., Newark—Jas. Graham Mfg. Co., Wells Ave., manufacturer of stoves, ranges, etc., has awarded the contract for two 1 story, 100x200 ft. manufacturing buildings.

Calif., Vernon—Union Die Casting Co., 2269 East 51st St., is having plans prepared by H. Eckart, Archt., 3345 San Gabriel Blvd., San Gabriel, for the construction of a factory. Estimated cost including equipment $37,000.

Conn., Bristol—Wallace Barnes Co., 30 Main St., is having plans prepared for a brick and steel addition to its rolling mill. Estimated cost $37,000.

Ga., Atlanta—King Plow Co., 1200 Marietta St., N. W., has awarded the contract for a 1 story, 200x200 ft. addition to its factory. Estimated cost $30,000.

Idaho, Twin Falls — City plans to construct machine shop in connection with municipal airport. Total estimated cost $150,000. J. E. Hayes, City Engr.

Ill., Chicago — Chicago Flexible Shaft Co., 5600 West Roosevelt Rd., has awarded the contract for the construction of a 1 story, 82x300 ft. factory. Noted Mar. 25.

Ill., Chicago—Zenith Radio Corp., 3620 South Iron St., plans to construct a new plant. Estimated cost will exceed $37,000.

Ill., Rockford—Rockford Screw Products Co. has awarded the contract for a 1 story, 100x 120 ft. addition to its plant. Estimated cost including equipment $37,000.

Ind., Anderson—Overmeyer Mould Co., Winchester, plans to construct a 1 story addition to foundry in North Winchester and a 2 story addition to main plant here. Estimated cost $25,000.

Md., Baltimore — C. J. Brandt, Bush and Ridgely Sts., will soon award the contract for the construction of a 1 story, 100x100 ft. sheet metal shop. Estimated cost $30,000. C. M. Schroter, 10 West Chase St., Archt.

Md., Baltimore—Crown Cork & Seal Co., G St. and Erie Ave., has awarded the contract for the construction of a 1 story, 280x880 ft. and 280x960 ft. "U" shaped building and a 3 story factory and warehouse.

Md., Baltimore—Flynn & Emrich Co., Geantly Rd. and Western Maryland R.R., is having plans prepared by W. S. Austin, Archt., Maryland Trust Bldg., for the construction of a 1 story, 80x200 ft. foundry. Estimated cost $50,000.

Mass., Cambridge—Dewey & Almy Chemical Co., H. L. Kennedy, Engr., 235 Harvey St., plans to construct a machine shop addition and will require machine tools.

Mass., South Hadley Falls—P. R. Sullivan, Main St., plans to rebuild 1 story, 40x80 ft. automobile body shop which was destroyed by flood. Work will be done by day labor. Machine tools will be required.

Mass., Springfield—Moore Drop Forging Co., 38 Water St., plans to rebuild its factory which was destroyed by fire and flood. Estimated cost $50,000.

Mich., Detroit—Ainsworth Mfg. Co., manufacturer of automobile accessories, has awarded the contract for a 2 story factory building. Estimated cost $50,000.

Mich., Lansing—Olds Motor Works, Olds Ave., has awarded the contract for a 3 story, 131x410 ft. plant. Estimated cost $275,000.

Mich., Muskegon—Standard Auto Parts, 660 Nims St., plan to construct an addition to their factory. Estimated cost will exceed $37,000. Roger Allen, 610 Lafayette St., S. E., Grand Rapids, Archt. and Engr.

Mich., Saginaw—Saginaw Steering Gear Corp., division of General Motors Corp., is having plans prepared by Frantz & Spence, Archts., 118 North Washington Ave., for the construction of a factory on Clinton St., for the manufacture of steering gears. Estimated cost $40,000.

Mich., Wyandotte—All-Metal Products Co. is having plans prepared for a 1 story, 103x300 ft. factory for the manufacture of automobile parts. Estimated cost $55,000.

Neb., Omaha — Gate City Iron Works, 11th and Seward Sts., have purchased a site adjoining their plant and plan to construct additional shops.

N. Y., Arcade—K. R. Wilson Foundry Co., 10 Lock St., Buffalo, has awarded the contract for rebuilding its factory destroyed by fire. Estimated cost $40,000.

N. Y., Binghamton—Binghamton Foundry & Machine Co., Floral Ave., plans to construct an addition to its plant. Estimated cost will exceed $37,000.

N. Y., Falconer—National Worsted Mills, J. G. Ellis, Gen. Mgr., P. O. Box 666, Jamestown, N. Y., has acquired a 3 story factory adjoining its textile mill here, and will rehabilitate same and install modern textile machinery and equipment.

N. Y., New York—R. E. Dietz Co., 60 Laight St., manufacturer of lanterns, will soon award the contract for altering its 9 story factory. Estimated cost $130,000.

N. Y., Rome — Rome Cable Co. plans additions and alterations to its factory. Estimated cost will exceed $40,000.

N. C., Greensboro—Mock-Judson-Voehringer Mfg. Co., J. K. Voehringer, Pres., will soon award the contract for an addition to its hosiery mill. Estimated cost $200,000.

O., Cincinnati — Cincinnati Milling Machine Co., Marburg St., has awarded the contract for an addition to its factory. Estimated cost $50,000.

O., Cleveland—Cleveland Window Shade Mfg. Co., Carl Lundquist, Pres., 7409 Wade Park Ave., is having plans prepared by W. H. Hatch, Archt., Hippodrome Bldg., for an addition to its factory. Estimated cost $30,000.

O., Cleveland—Willard Storage Battery Co., East 131st St. and St. Clair Ave., will soon award the contract for the construction of an addition to its factory. Estimated cost $30,000. P. H. Voth, Engr.

Pa., Erie—Lovell Manufacturing Co., 13th and Holland Sts., has awarded the contract for an addition to its spring and casting plant. Estimated cost including equipment $40,000.

Pa., Homestead—Mesta Machine Co. will construct extensions and additions to its plant. Separate contracts have been awarded for the work. Estimated cost including equipment $750,000.

Pa., Pittsburgh — Jones & Laughlin Steel Corp., 3rd and Ross Sts., has awarded the contract for machinery for new steel sheet and strip mill. Estimated cost $22,000,000.

R. I., North Smithfield—Branch River Wool Combing Co., Inc., has awarded the contract for a 2 story, 85x356 ft. addition to its factory. Estimated cost including equipment $100,000.

Va., Waynesboro—Crompton-Shenandoah Co. has acquired the building here formerly occupied by the General Electric Co. and will convert same into a textile plant. Separate contracts have been awarded for the work. Estimated cost including machinery and equipment $37,000.

Wash., Hoquiam—Grays Harbor Chair & Mfg. Co., Port of Grays Harbor, has awarded the contract for an addition to its factory. Estimated cost $50,000.

Wash., Seattle — Boeing Aircraft Co., 200 West Michigan St., has awarded the contract for the construction of a plant on 14th St. Estimated cost $250,000.

Wash., Spokane—Brown Metal Works, E404 Sprague St., plans to construct a factory for the manufacture of aluminum bus bodies.

Wis., Milwaukee—International Printing Ink Corp., 522 North Jefferson St., will soon take bids for the construction of a 2 story manufacturing building to replace the one destroyed by fire. John Brackett, 50 Church St., New York, N. Y., Archt.

Wis., Neillsville—E. Brunn and M. Feuerstein will construct a 1 story, 50x60 ft. machine shop. Work will be done by day labor. G. A. Krasin, Marshfield, Archt.

Ont., St. Catherines—English Electric Co. of Canada, Ltd., 660 St. Catherines St., W. plans to construct a factory for the manufacture of electric light bulbs. Estimated cost $200,000.

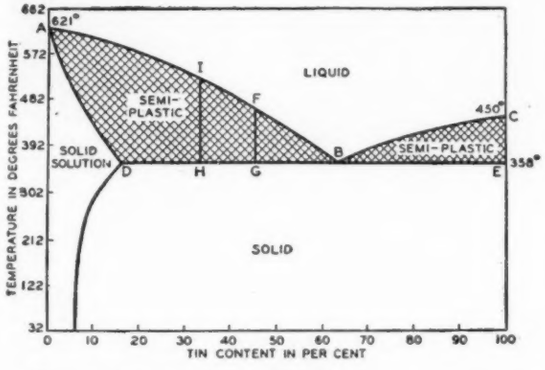
Que., Beauharnois—St. Lawrence Alloys, Ltd., c/o Blekley & Harries, 36 Toronto St., Toronto, Ont., plans to construct a factory here for the manufacture of ferro alloys. Estimated cost $100,000.

Que., Montreal—Metal Industries Corp., A. E. Laverty, Secy., 414 St. James St., W., is having plans prepared for the construction of a plant.

American Machinist REFERENCE BOOK SHEET ©

Soft Solders

Soft, or so-called "hand" solders, are so known because of the relative ease with which they are melted. Most alloys of lead and tin, indeed all those containing from 16 to 100 per cent of the latter metal, soften at 358 F., as shown by line *DBE* in the accompanying illustration. In that figure, the line *ABC* indicates temperatures at which all alloys of lead and tin completely liquify. In the intermediate temperature range between lines *ABC* and *DBE*, which is shown by the cross-hatched area, the solder is semi-plastic, partially liquid and partially solid.



Temperature ranges within which various alloys of lead and tin are liquid, semi-liquid and solid

This range is important in determining the temperature at which a soldering iron should operate and the speed at which the soldering can be done. Thus, when used with any particular soldering iron the solder having the greater semi-plastic range will liquify somewhat slower and will take longer to solidify completely than that having a lower range. For example, the semi-plastic range for the 45 per cent tin—55 per cent lead solder as shown by line *FG* is 114 F. and the range for the 33 per cent tin—67 per cent lead solder as shown by line *HI* is 172 F. It is obvious, therefore, that it will take slightly longer to make a soldered joint using the 33 per cent tin solder than by using the 45 per cent tin solder. However, in order to take advantage of the saving in cost of the lower tin content solders, the recent developments in soldering irons have been along lines to increase their efficiency, and to operate at higher temperatures.

From the illustration it is evident that if two parts are to be joined by soldering and are to function under operating temperatures in excess of 358 F. it will be necessary to use a solder having a tin content of less than 16 per cent, because any alloy having a greater tin percentage than 16 per cent will begin to soften or become semi-liquid.

While soldered joints are not recommended for use at elevated temperatures, because the ultimate tensile strength falls off sharply with elevation of temperature, a lead-tin alloy having a tin content of 4 per cent has been found satisfactory for use under conditions where apparatus must function at temperatures within the semi-liquid range of the ordinary hand solders, and where very little stress is applied to the solder joints.

Compared to the metals being joined, soft or lead-tin solder is inherently weak, having an average ultimate strength of 4,000 lb. per sq.in. at room temperature. Therefore, since the ultimate tensile strength of the solder is low as compared to the metal parts to be joined, the joints must be of sufficient area to bear the stresses. Consequently, lap joints are preferable to butt joints. Soft solder, like the lead and tin of which it is composed, offers very little fatigue resistance.

Materials Used for Typical Soldering Jobs

Job	*Solder*	*Flux*	*Neutralizer*
General electrical connections in assemblies which cannot be washed.	45 % tin—55 % lead or 33 % tin—67 % lead	Rosin.	None.
Running seams on sheet metal (other than lead and its alloys).	45 % tin—55 % lead or 33 % tin—67 % lead	Soldering salts. (Ammonium chloride and zinc chloride.) Naphthalene. Tetrachloride.	Cyanide wash, hot water wipe or alcohol wash.
Copper, brass, phosphor bronze, nickel, silver, tinned and untinned sheet.	45 % tin—55 % lead or 33 % tin—67 % lead	Soldering salts. (Ammonium chloride and zinc chloride.) Naphthalene. Tetrachloride.	Cyanide wash, hot water wipe or alcohol wash.
Galvanized iron sheet.	45 % tin—55 % lead or 33 % tin—67 % lead	Soldering salts. (Ammonium chloride and zinc chloride.) Naphthalene. Tetrachloride.	Cyanide wash, hot water wipe or alcohol wash.
Wiping and soldering lead joints.	40 % tin—60 % lead	Stearic acid.	Burning.
Tinned parts that can be washed after soldering.	45 % tin—55 % lead or 33 % tin—67 % lead	Naphthalene. Tetrachloride.	Alcohol wash.
Splicing copper wire where low electrical resistance and high strength are essential.	20 % silver, 45 % copper, 35 % zinc*	Borax.	None.
Repairing brass castings where high strength is essential.	45% silver, 30 % copper, 25 % zinc*	Borax.	None.

*These are not what are generally termed soft solders, a torch being required.

Abstracted from an article by A. H. Falk, Telephone Apparatus Department, Bell Laboratories, and published in the *Bell Laboratories Record*, Vol. 14, No. 3.

Ideas FROM PRACTICAL MEN

Indexing the Machine Vise

OCTAVE ANTONIO

With milling machine vises equipped with special jaws, many small troublesome parts can be milled with dispatch in a hand miller. When, however, several cuts are to be taken at accurate related angles to one another, rapid and accurate indexing is called for.

We have solved such problems by using an ordinary Brown & Sharpe swiveling vise and fitting it with special jaws and indexing stops. For locking the vise in the indexed positions, the long screw *A*, Fig. 1, was substituted for the regular clamping screw. Besides being long enough to be conveniently reached, it is provided with a handle for ease of operation.

Referring to Fig. 1, the two round pieces in the vise are to be cut away to the center line on the end and are to be straddle milled at 90 deg. from the first cut. These pieces are shown enlarged at *B*. At the left, the vise is shown in position for making the first cut with cutters *C* and *D*. At the right it is shown indexed 90 deg. for making the second cut with straddle mills *F* and *H*. As the second cut is a light one, the pieces can be fed rapidly between the cutters.

When the vise is positioned for the first cut, the stop screw *I* is in contact with the fixed stop *K*, but when it has been indexed 90 deg., stop screw *L* contacts the stop plate *M*. Fine adjustment is made by adjusting the stop screws. In some jobs the cuts may vary in depth, so that it may be necessary to use cutters in which the diameters bear the proper relation to one another.

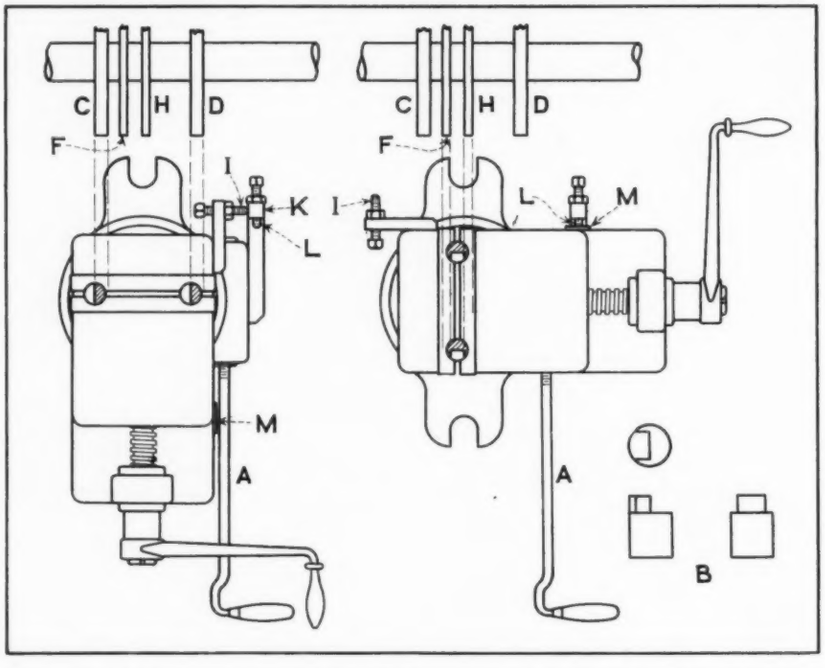


Fig. 1—Cutters are not symmetrically spaced on the arbor because the swiveling center will seldom fall on the centerline between the pieces

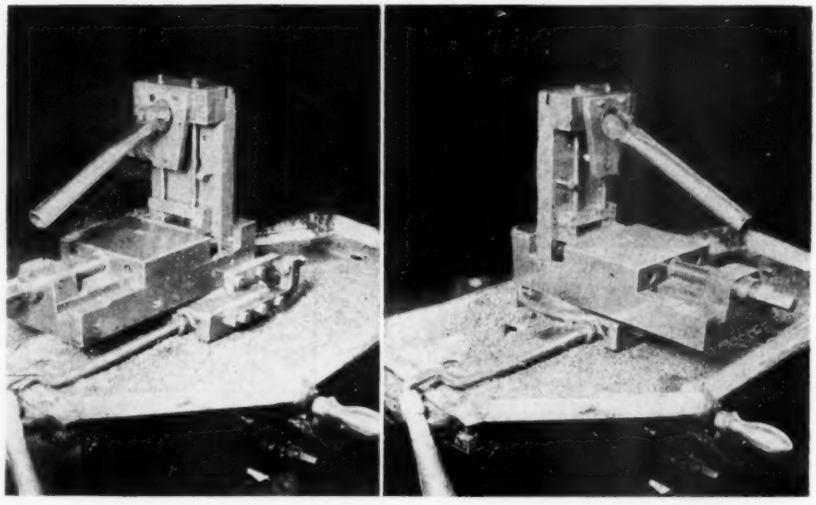


Fig. 2—Work too long to be held vertically in ordinary vise jaws can be clamped in auxiliary jaws. The vise is shown in both indexed positions

In Fig. 2 is shown a set-up for long work in which the work is clamped in auxiliary jaws having an outboard clamp, the auxiliary jaws being held in the vise. The vise is shown in both indexed positions.

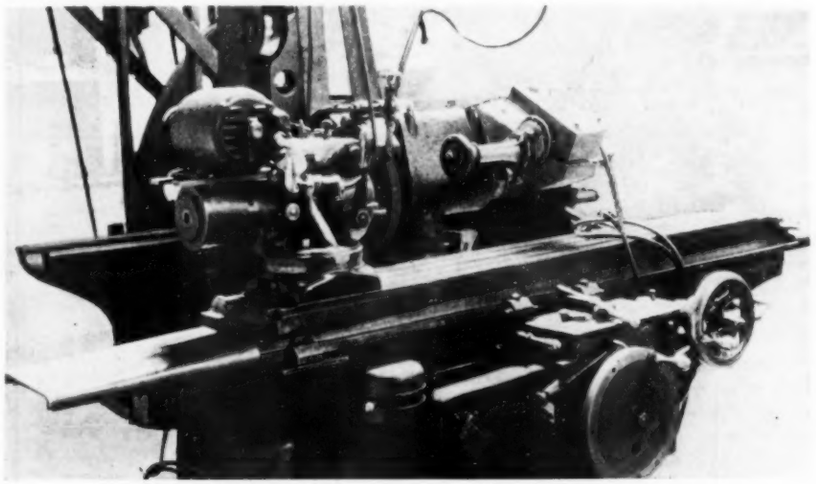
Internal Grinding With a Portable Grinder

M. L. LOWREY

An electric mine locomotive was sent to the shop for general overhauling and among the wornout parts to be replaced were the two driving sprockets. The only ones we had in stock had holes 0.10 in. too small, the hubs being 4½ in. long. These sprockets were hardened, not surface hardened, but hardened clear through, and were

too hard to be rebored with a tungsten-carbide tool, so the only answer was to enlarge the holes by grinding.

The only internal grinding attachment available had a spindle $\frac{5}{8}$ in. in diameter and $4\frac{1}{2}$ in. long. As it was impossible to do the work with this light attachment in the time we had to make the repairs, we secured a portable electric grinder to the wheel head of our grinding machine with wooden clamps, as shown in the illustration. The work was chucked in the usual way and by keeping the grinding wheel dressed, the job was done in fair time.



With a portable electric grinder clamped to the wheelhead of the grinding machine, holes $3\frac{1}{4}$ in. in diameter and 4 in. long in hardened steel sprockets were enlarged 0.10 in. in fair time

We had expected to rough out the holes with the portable grinder and finish them with the regular internal attachment, but found we were getting such good holes that we finished them with the portable grinder.

Shearing Blanks in the Power Press

CHARLES H. WILLEY

Quite often when a small drawn or formed part is being hurried into production, to save time before the blanking tools have been made, square or rectangular blanks are cut from strips of the correct width. While in small shops the blanks are usually cut in foot-operated shears, we have saved considerable time in work of this kind by using the standard shearing tools illustrated in the power press.

The guide *A* is formed to suit the width of the strip to be sheared. It is simple and easily made, as shown in the lower part of the illustration, and is attached to the lower shear blade. The stop *B* is adjustable for the length of the blanks and is attached to the die. Since the opening in the die is amply large, the blanks fall through it.

Welding and Shaping Gear Teeth

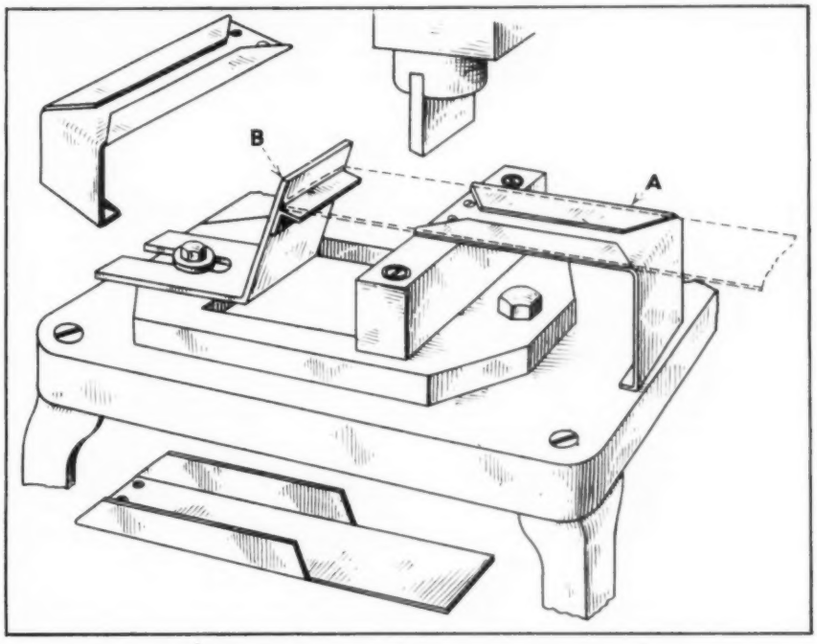
O. D. BRADSHAW
Fredericton, New Brunswick, Canada

Referring to the article by H. M. James under the title given above (*AM*—Vol. 80, page 170), large gears having broken teeth can have new teeth built up by depositing metal by welding, pre-heating the portion of the rim near the broken teeth and using a carbon block to act as a dam for the molten metal. The carbon block is shaped accurately to fit the tooth space of an undamaged portion of the gear, thereby eliminating any after finishing of the welded teeth.

Some time ago I repaired the clutch gear of a large tractor which had diametrically opposite teeth broken out. The gear was surface hardened and to avoid annealing the adjacent teeth I resorted to arc welding for building up the new teeth, using a shielded-arc rod of high-tensile strength. First, I ground down the sections of the broken teeth to take out any cracks and then placed metal shields on adjacent tooth faces to protect them from the heat, and deposited enough metal to leave stock for finishing.

Having no cutter of the required pitch, I made two fly cutters, relieving the opposite sides so that they would not strike the hard flanks of the adjacent teeth.

The gear was placed in a gear cutter and the fly cutters were adjusted to conform with the flanks of an undamaged tooth and the gear was indexed to one of the welded teeth. Each tooth was then roughened out, leaving enough stock for a light finishing cut, which was made in two operations for each tooth, one on each side. After the teeth were finished they were case-



Standard shearing tools are more productive for small blanks that are wanted in a hurry

hardened. The adjacent teeth were packed with fireclay and powdered asbestos and the teeth were heated with a welding torch. Powdered cyanide of potassium was applied and the teeth were quenched in a light oil. The gear has been in use for some time and has given satisfactory service.

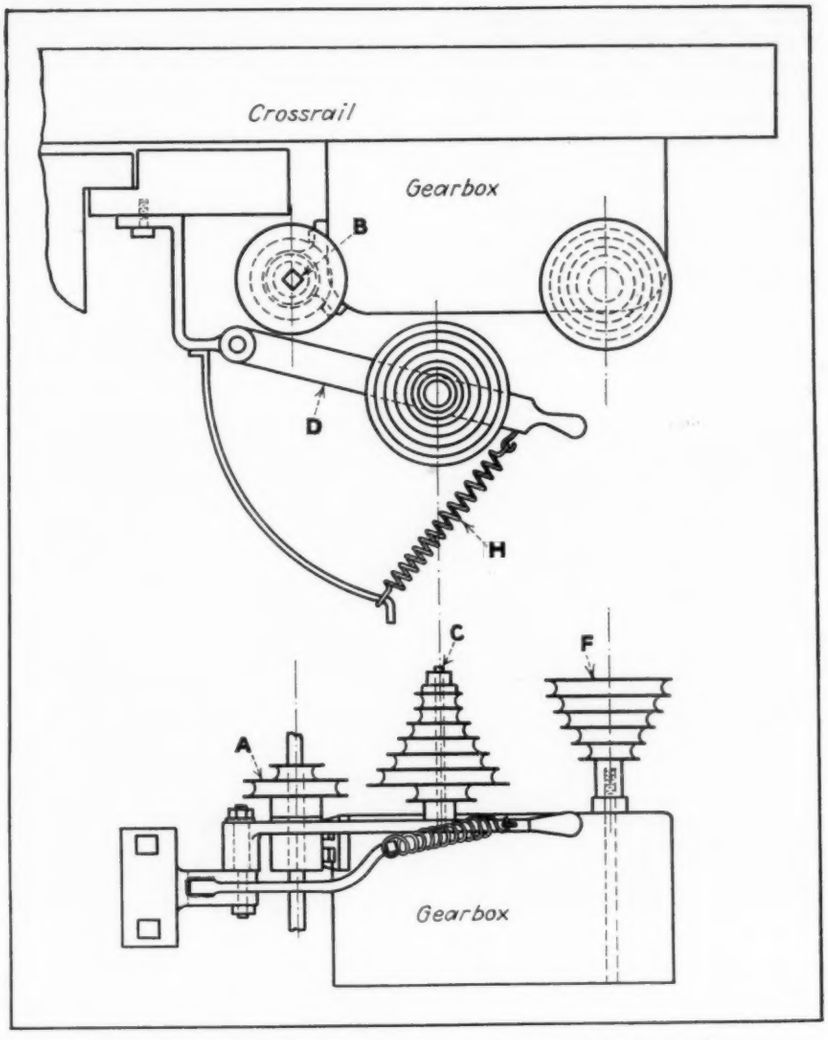
Replacing a Friction Feed

WILLIAM C. ELLIS

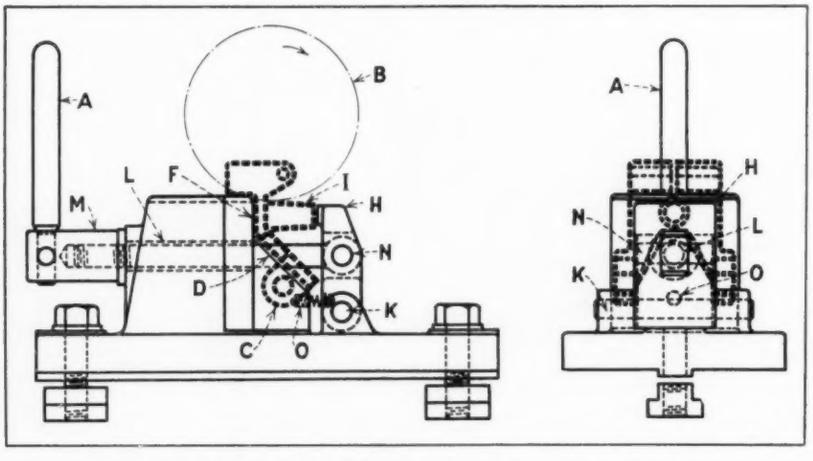
We had considerable trouble with the disk-type friction feed on a large vertical boring mill, and repairs and replacements at inopportune times caused us to devise the feed illustrated.

Essentially the device consists of the two-step driving cone *A* mounted on the square, vertical drive shaft *B;* the seven-step idler cone *C* mounted on the lever *D;* and the five-step driven cone *F* mounted on the vertical shaft that drives the feed through gears. All the cones are grooved for $\frac{3}{8}$-in. round belts. The lever *D* is pivoted to one of the crossrail clamps and is slotted to permit adjustment of the idler cone to keep the belt from the driving cone tight. The spring *H* pulls the lever so as to keep the belt from the idler cone to the driven cone tight at all times, except when the lever must be moved to permit either of the belts to be shifted from one groove to the other.

The ratios from the driver to the idler cones are 1 to 2 and 2 to 1, and the ratios from the idler to the driven cone are 2 to 1, $1\frac{1}{2}$ to 1, 1 to 1, 1 to $1\frac{1}{2}$, and 1 to 2. This arrangement gives ten progressive steps of feed varying from $\frac{1}{32}$ to $\frac{1}{2}$ in. per revolution of the table, which are about right for the average range of work.



This arrangement of cone pulleys operated by round belts took the place of a troublesome friction feed of the disk type on a large vertical boring mill



The pivoted clamp holds the work against the vertical surface of the central block and is operated by the lever at the left through a threaded sleeve and an eyebolt

Slotting Fixture

FRANK HARTLEY

One feature of the slotting fixture illustrated is the convenient location of the clamping lever *A*, as it is a considerable distance from the work, which is indicated by heavy dotted lines. It is also at a considerable distance from the cutter *B* when the fixture is in location for loading and unloading the work.

The work to be slotted has two projecting ears at C, which straddle the locating block *D*. The upper portion of the work rests on top of the central block, and the vertical face is clamped against the surface *F* by the pivoted clamp *H*, which contacts the boss *I*. The clamp is pivoted by the stud *K*, about which it rotates as a center, and is operated by the eyebolt *L*

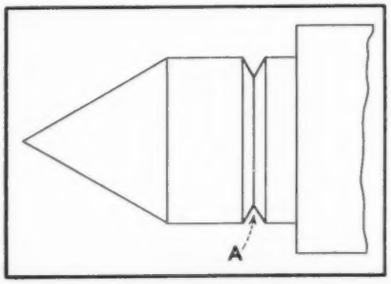
through the threaded sleeve *M* and the clamping lever *A*. Pin *N* connects the eyebolt to the clamp. When the clamp is released, spring *O* keeps it open so that work can be loaded and unloaded without interference.

Convenient Gage for Setting Thread Tools

J. E. MOORE

Gages for setting thread tools, generally known as center gages, are small and are likely to get lost or mislaid. Besides, they must be held accurately in axial line with the work when setting the tool.

A convenient gage for setting thread tools can be made by cutting a V-groove having an included angle of 60 deg. in the body of the tailstock center of the lathe, as shown at *A* in the illustration. Such a gage is a permanent fixture so long as the center remains in place.



So long as the tailstock center remains in place, the gage for setting thread tools is a permanent fixture

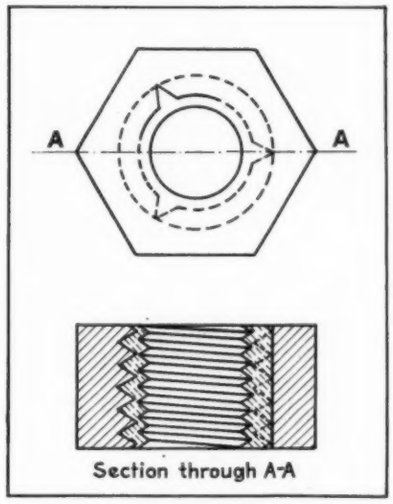
A "Break-Out" Fitting

ELTON STERRETT

As an example of the problems that confront machine shops in the oil fields, the superintendent of a pipe line in eastern Texas brought in a snap shot of a connection from the bottom of a tank and ordered one to be made with a satisfactory "break-out" flange for delivery the following day. The flange was to be used on the delivery end of a pipe line and must break at 100-lb. pressure to protect valves and fittings in case a gate at the delivery end was closed and the flow of oil was suddenly stopped.

A number of schemes, such as cutting concentric grooves in the flange, sawing radial slits part way through the metal and drilling blind holes, were tried without success. Finally, in an attempt to get away from the unsatisfactory "break-out" flange, it was decided to experiment with the nuts for the eight ¾-in. bolts that held the flange in place.

Each nut was tapped for a ⅞-in. bolt and three V-grooves, 120 deg. apart, as shown in the sketch, were cut into the threads with a hacksaw. After cleaning the nuts to remove all traces of oil they were taken to a print shop and poured full of molten linotype metal, which was anchored in the V-grooves.



Nuts having threads cut in type metal were used in attaching a blank flange that must yield enough at 100 lb. to relieve excess pressure on an oil-well pipe line

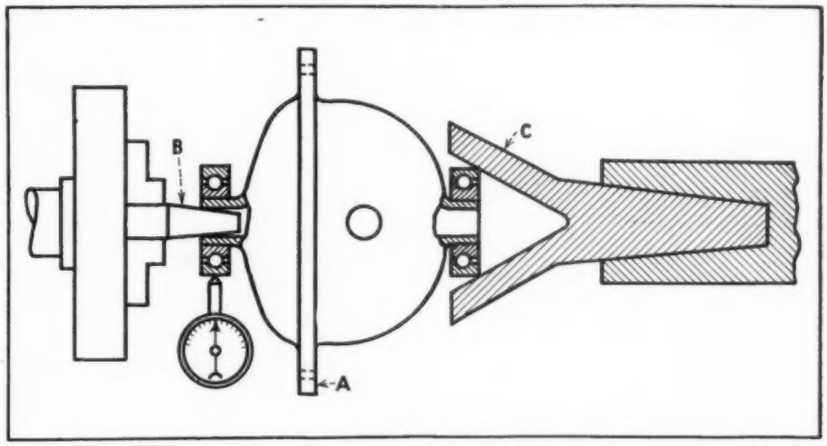
The type metal centers were drilled out and the nuts were then tapped for ¾-in. bolts, leaving a thin bushing of type metal. The flange was attached to a fitting connected to a hydraulic test line, but the pressure required to strip out the type metal exceeded the required limit. The nuts were then thinned and were replaced. When the gage showed a pressure of 100 lb. there was no leak, but when the pressure was built up to 102 lb. the type metal yielded enough to relieve the pressure. On a second test the type metal yielded at 97 lb. Without waiting for a third test the superintendent accepted the job.

Worn Differential Flanges Refaced

H. M. JAMES
James Machine Works

We do a large amount of maintenance work on automobiles, trucks and tractors and are often called upon to true up damaged flanges *A* of ring-gear carriers. Since the flanges must be true with the supporting ball bearings, the work is difficult to hold in the lathe because there are no centers in the ends of the carriers.

We solved the difficulty by the use of the very simple tools shown in the ilustration. A piece of round stock *B* held in the chuck was turned to a taper to fit tightly in the straight opening for the axle shaft in one end of the carrier and the carrier was lightly pressed on it. The cup center C was held in the tailstock spindle and was brought up to the ball race on that end, holding the race stationary. A dial indicator was used to check the truth of the race next to the headstock end. If the race did not run true, it was trued up by adjusting the chuck jaws. With both ends of the carrier running true with their own supporting bearings, the flange was faced in the usual manner.



One end of the carrier is supported by a taper plug held in the chuck, while the opposite end is supported by a cup center held in the tailstock spindle

Shop Equipment NEWS

Gorton Nos. 3-B and 3-L Die and Mold Duplicating Machines

The George Gorton Machine Co., 1103—13th St., Racine, Wis., has added three-dimensional machines in two sizes to its line of pantograph machines for engraving and die and mold cutting. These three-dimensional machines are adapted for cutting all kinds of dies and molds having ornamental designs and lettering. They reproduce in reduced ratio direct from models of any shape or contour. The models may be of stone composition, bakelite, hard wood or other materials, or from metal templates and master copies. Reproduction ratios range from one-half to one-eighth size of model or master.

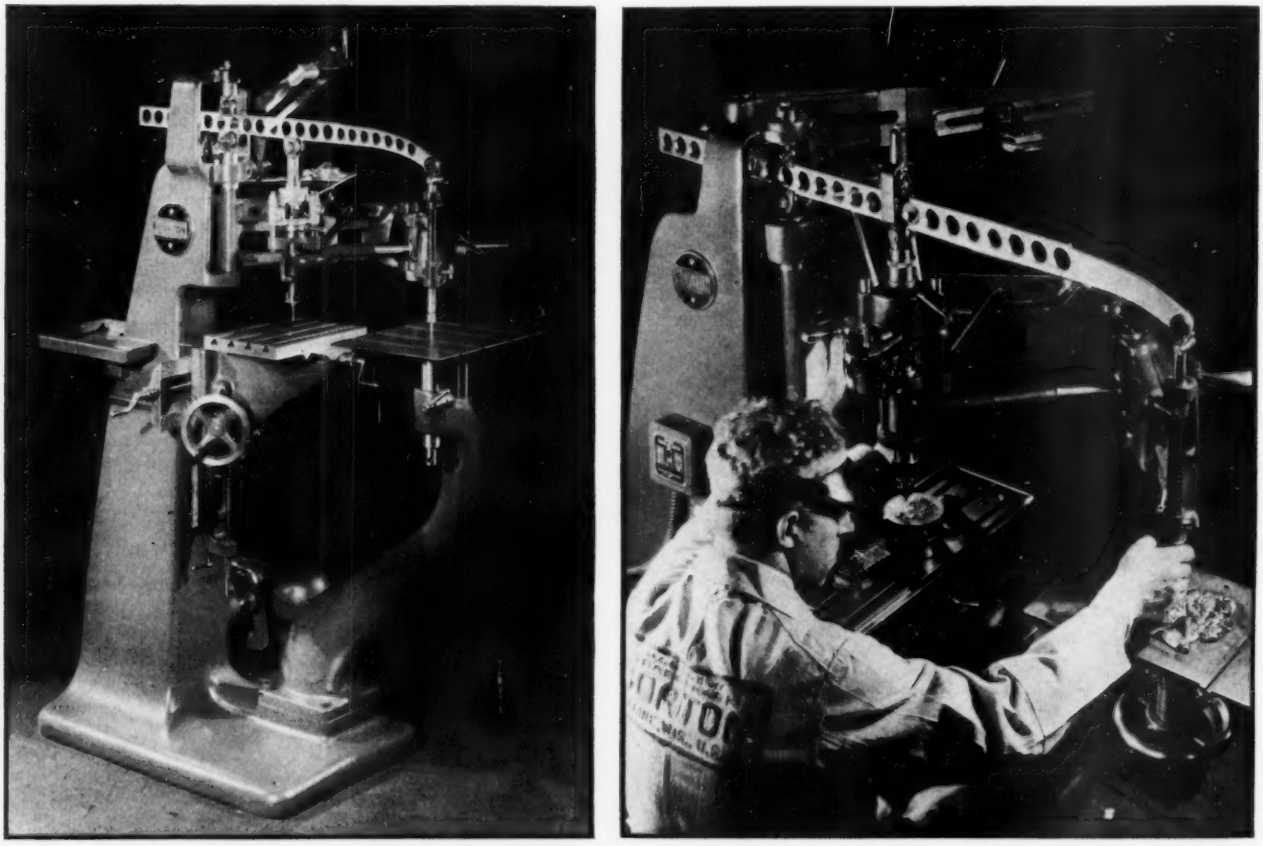
An important feature is that the cutter spindle and tracer are always truly vertical with relation to the work. Depth of cut is not obtained by hinging the pantograph, thus causing an under-cut on one side of a deep mold. Uniform pressure of tracer against the model is maintained at all times without the use of a counterweight to balance the pantograph. Thus, the operator does not have to lift and hold the pantograph against the thrust of cut in two directions.

The high-speed spindles are mounted on precision ball bearings and all pantograph joints are ball bearing, as well as the motor drive parts. Tables, saddle and knee are of simplified, conventional milling machine design with hand feeds.

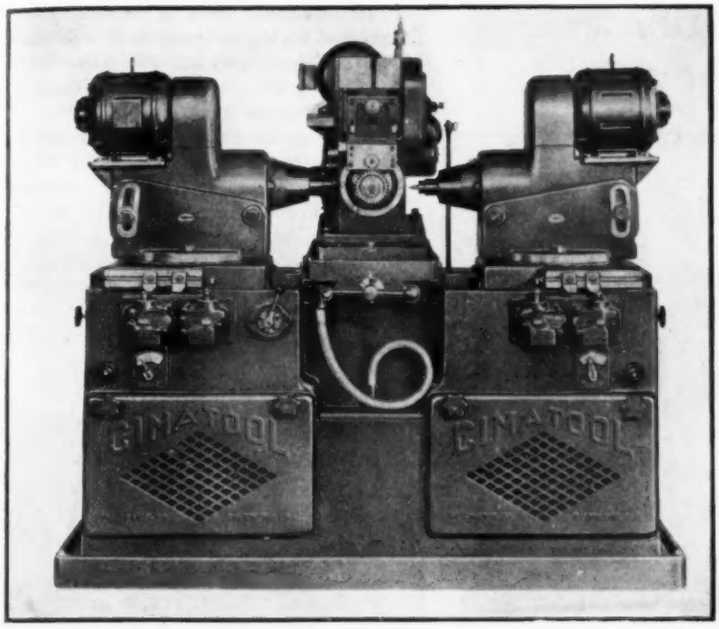
The No. 3-B, a small size machine, will cut a maximum cavity of 6x12 in., and to almost any depth in one setting. The No. 3-L, medium size machine will cut a maximum cavity of 9 by 18 in. and almost any depth at one setting.

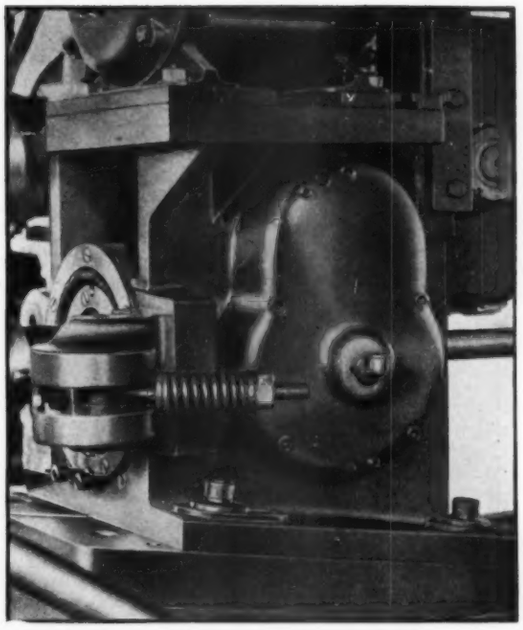
Hanna Electric-Hydraulic Riveter

An electric-hydraulic riveter has been built by Hanna Engineering Works, Inc., 1765 Elston Ave., Chicago, Ill. It is self-contained, has flexibility of speed and load ratio. It also has cushioned application of force and ability to take peak loads. The riveter is



On Gorton die and mold duplicating machines, models can be reproduced in reduced ratio from ½ to ⅛ size. At the left is shown the No. 3-B, small size machine, and at the right a close-up of the No. 3-L reproducing from a model

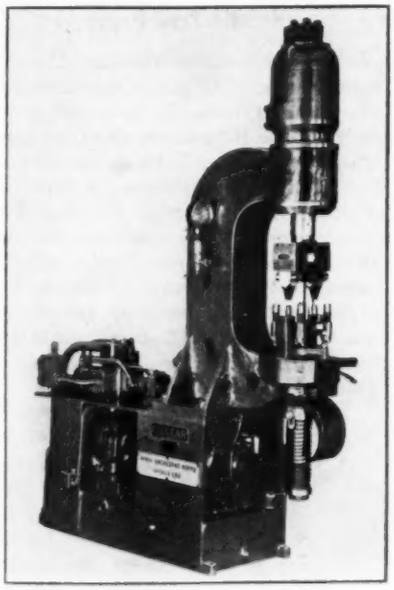




Left—By using two spindles this Cimatool Peerless Gear Chamfering Machine doubles production; speed is 300 teeth per min. Right—Side view of the work head and the readily removed cam plate shield as well as the spring tension provided on the opposite side of the cam

equipped with an Oilgear fluid-power pump direct driven by an electric motor through a flexible coupling. Pump, motor, valves and circuits are mounted on a rigid combination base and oil pot.

Initial work or closing movements are performed at high speed and low pressure. Maximum pressures may be regulated to the work, thus holding the power consumption to a minimum and avoiding distortion of the work.



Hanna Electric-Hydraulic Riveter which exerts 80 tons pressure

Cimatool Peerless Duplex Gear Chamfering Machine

Double the production is secured from the double-spindle model of the "Peerless" gear-tooth chamfering machine built by the Cimatool Co., East Third at June St., Dayton, Ohio. This larger and heavier machine is hydraulically operated. It chamfers and burrs all external gears up to 13 in. in diameter, utilizing cutting speeds as high as 300 teeth per min. It permits chamfering of two teeth simultaneously on the same gear, thus cutting production time in half.

The same flexibility as regards different shapes of chamfer and roundness is retained in this double-spindle model. A heavier anti-friction bearing work head provides the same continuous rotating indexing action timed with a forward and backward motion produced by a cam. The cutter spindle is stationary during the cutting operation. The machine utilizes inexpensive pencil-type cutters which may be ground back until only the shank remains. For unloading and loading, the cutter spindles move out of and into the cutting position under hydraulic control.

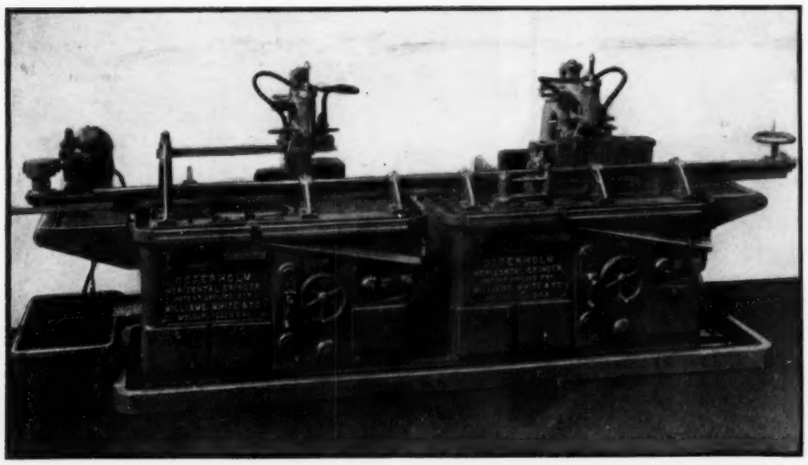
All hydraulic controls are convenient to the operator. The coolant system is integral with the machine. Rapid clamping is provided by hydraulic action.

The same mechanism as in single-spindle models is utilized in this machine for timing the part. The camshaft diameter has been increased and a bearing support used on both ends. Wear adjustment take-up is provided through the entire head on all mating gears and worms. The cutter spindles have a swivel adjustment in the horizontal plane in order to provide any required angle on the face of the chamfer. In addition, the cutter spindle has a vertical swivel through a fulcrum, to enable securing any angle desired on the chamfer or degree of roundness, which are desirable in the chamfering of helical gears.

"Sterling Cord" Air Hose

An air hose of cord construction has been announced by the New York Belting & Packing Co., Passaic, N. J. This "Sterling Cord" is built like a tire, with the cords laid in tough rubber cushions and isolated from adjacent plies. Chief among advantages claimed are lighter weight, more flexibility and greater resistance to pressure. The compounded cover shows resistance to bruises and abrasions. Oil-resistant rubber is used in the tube.

Osterholm Horizontal Grinder in Tandem Set-up



Showing Osterholm grinders set up in tandem for high production roughing and finishing of engine blocks. Production of 150 to 175 per hour, with accuracy of 0.003 in. is possible

Several tandem set-ups of the Osterholm horizontal surface grinders have been placed with a prominent motor builder, Williams, White & Co., Moline, Ill., announces. The grinders have tables consisting of the feed table, a circular plate support, and a take-off table. The ring-type wheel is set so that it is flush with the top of the center plate, and the depth of cut is regulated by adjusting the height of the feed table relative to the wheel. Work passes from the feed table across the wheel to the center plate and the take-off table and travels in a true plane, giving a flat surface. Either the weight of the work or a hold-down holds it down against the wheel. Mechanical means feed it across the wheel at a uniform rate of speed.

The ring wheel is mounted on a vertical spindle which is direct-motor driven. The spindle and its housing are mounted in vertical guides in a frame, and can be raised to compensate for wear of the wheel by a graduated handwheel and screw. Table surfaces are deeply grooved to prevent collecting grinding débris. Water is introduced to the spindle, and dispersed through ducts in the center plate to the point of contact of the work on the wheel. Coolant is forced through the center plate by pressure from a motor-driven centrifugal pump in the base of the machine.

In the tandem arrangement operation is continuous, speed being set by the chain feed. By using them in tandem, any number of wheels can be arranged in a single frame where high production is called for. All controls for depth cut, rate of feed and wheel adjustment are within easy reach of the operator. The first machine takes off a rough cut, and the second makes the finish cut. The tandem arrangement can rough and finish from 150 to 175 cylinder blocks an hour, with an accuracy of 0.003 in., when checked on a surface plate.

Ex-Cell-O No. 46 Carbide Tool Grinder

No. 46 carbide tool grinder is designed for rapid, economical grinding and lapping of single-point, cemented-carbide-tipped turning, facing and boring tools. Diamond wheels, silicon-carbide, vitrified cup wheels or diamond lapping disks can be used. A roughing and finishing cut can be taken with two silicon-carbide cup wheels; roughing with silicon carbide cup wheel and finishing with diamond wheel; or roughing with silicon carbide vitrified cup wheel and lapping with a diamond lapping disk can be done with this machine, produced by Ex-Cell-O Aircraft & Tool Co., 1200 Oakman Blvd., Detroit, Mich.

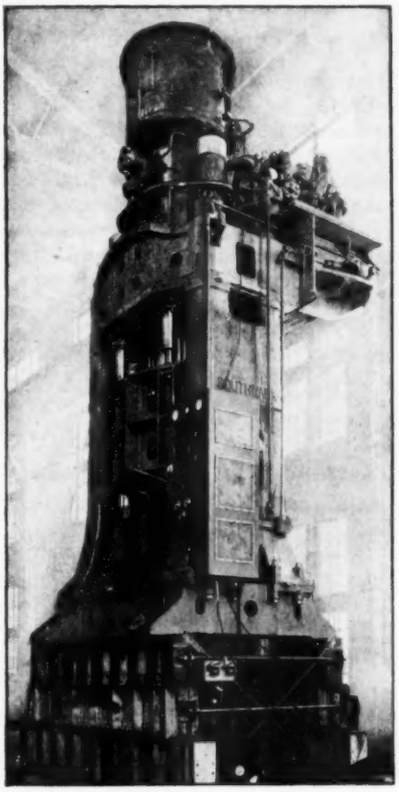
Tools up to 5/8 in. square shank can be rough and finish ground with silicon carbide vitrified wheels. When grinding with diamond wheels or lapping with the lapping disk, larger size tools can be handled. The grinder is of the double-end type. An adjustable tool support table with a hardened and ground surface is located at each end of the machine with a 2-in. adjustment for wheel wear and to obtain the correct rake and angle on the tools. A slot across the face of each table guides the tool protractor guide and wheel dresser. A graduated scale on each table affords an adjustment of 16 deg. above or below center. The protractor tool guide is adjustable through a full range of 180 degrees. A coolant reservoir is in the upper part of the wheel head for diamond wheel grinding. The machine uses 6 in. wheels.

Southwark "Hyspeed" 1,300-Ton Press

Designed for deep drawing of aluminum sheets, a 1,300-ton double-acting Southwark "Hyspeed" hydraulic press, built by the Baldwin-Southwark Corp., Philadelphia, Pa., is being installed in the plant of the Aluminum Cooking Utensil Co., New Kensington, Pa. The die descends at high speed until it contacts the blank, when it automatically slows down until the drawing has started and then speeds up, completing the operation at high speed. This prevents scoring or marring the highly polished aluminum plate.

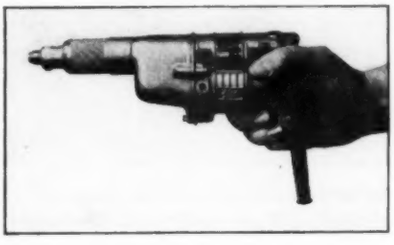
The over-all height of the press is 36 feet. It has a "daylight" of 86 in. and the clearance between the columns, right to left, is 84 in. Two double-acting push-down cylinders for draw work, and a main cylinder for the maximum setting tonnage are located in the inner slide. This slide exerts a maximum pressure of 1,000 tons and has 50-in. stroke. Attached to this

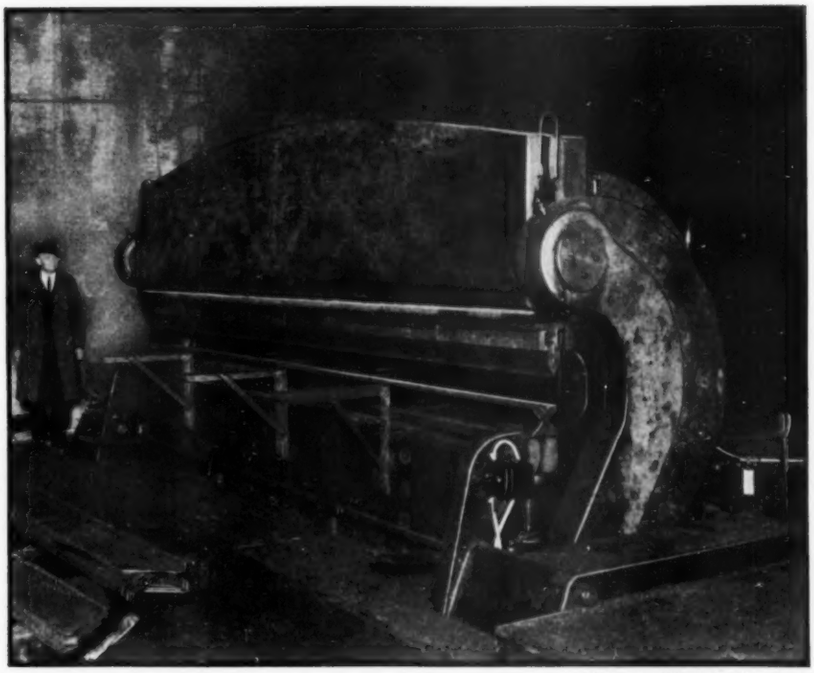
inner slide is a mechanical stripping mechanism operated by the up motion of the slide. The outer slide, with 25 in. stroke, has two screw stops which can be adjusted for any required pressure on the clamping ring of the die. It has a maximum capacity of 320 tons.



"Thor" One-Hand Electric Screwdriver

A smaller, lighter portable electric screwdriver for driving all sizes of screws from No. 4 to No. 12 by changing the finder and bit, has been introduced by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. This "Thor" U16 electric driver is radically different in design and construction, following the design of the U14, recently announced. All weight is concentrated right at operator's hand. The screwdriver is 10½ in. over-all, and can be used in places ordinarily inaccessible.





Lincoln Electric Co. photo.

Boom All-Welded 500-Ton Brake

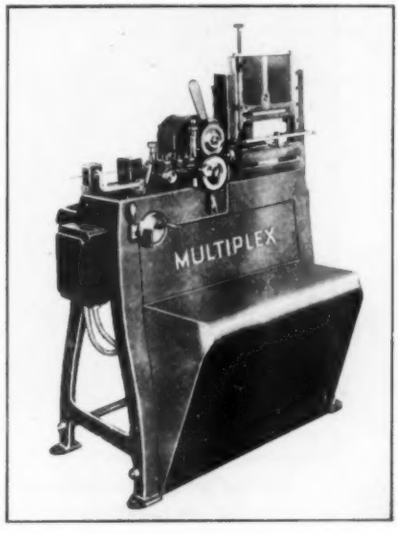
A 500-ton steel press brake, one of the largest of its type ever manufactured, and capable of bending materials 16 ft. long, is announced by Boom Boiler & Welding Co., Cleveland, Ohio. The brake pulls two leaves together instead of pushing one leaf down.

The brake is 24 ft. 2 in. long overall, 16 ft. 1 in. long between housings, 7 ft. 1 in. wide, 9 ft. 11 in. high and 6 ft. 9 in. high above the floor. It weighs 61 tons. The two leaves of the brake are 17 ft. 7 in. long, 4 ft. high, 10 in. thick and weigh 8 tons. Bending members are of high-carbon steel, machined to meet bending requirements. Construction is entirely of steel, arc welded and no castings are used. All welding was done by the shielded arc process with equipment supplied by The Lincoln Electric Co., Cleveland.

Multiplex High Production Wire-Forming Machine

The "Multiplex," built by Economy Tool & Machine Co., 10 West Delano St., Muskegon, Mich., is an automatic machine for forming soft wire. The wire feeds into the machine from a reel, is automatically straightened, cut to the desired length and formed with dies to specifications. The length of wire being produced and formed can be varied while the machine is in operation, by loosening the adjusting lock and turning the small handwheel which adjusts the cutting of wire to desired lengths. Less than five minutes is required to change dies and adjust the machine for production.

High-speed anti-friction and bronze bearings reduce power requirements. The company can furnish forming dies to any specifications for use in the machine. The capacity of the "Multiplex" is up to No. 10 gage and 21 in. in length. Its production capacity is 100, 125, or 150 accurately formed wires per minute. A 1-hp. geared motor on adjustable sliding base drives it.



LeBlond Special Chucking Lathe

A special automatic lathe for turning a grease-retainer groove in the bore of a ball-bearing race has been furnished by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This 11 in. lathe has a New Departure drive, a tool carrier that moves in and returns by air, and a cam-operated feed.

Spindle drive is from a New Departure "Transitorque" variable-speed unit up to the drive pulley by means of V-belts, through a Pullmore clutch and brake, and finally through a right angle worm drive. The speed variations are infinite from 100 to 600 r.p.m. Cross feed drive is taken off the clutch shaft, coarse changes being obtained through pickoff gears and three fine increments through a sliding gear. This arrangement gives feed rates from 0.0015 to 0.010 in. per rev.

The feed is engaged by the tool slide being brought up to working position through an air cylinder arrangement. The feed cam is carried in the tool arm and engages a clutch in the headstock, giving about ⅛ in. cross feed. When the groove has been turned, the tool slide drops clear of the work, then the cam trips a trigger, reversing the air cylinder to put the slide in the loading position. The work is held in an air-operated collet controlled by the small handle on the left. The larger handle is for moving the slide into the working position and engaging the feed. The ball handle is an emergency trip for withdrawing the tool arm at any time during the cycle.

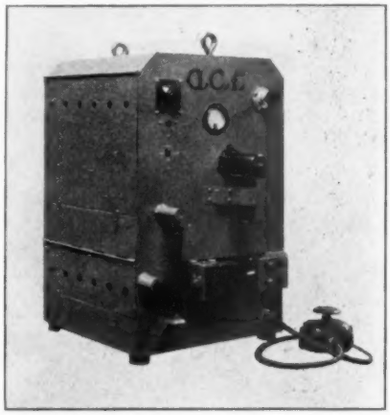
"Do-All" Bandsawing and Filing Machine

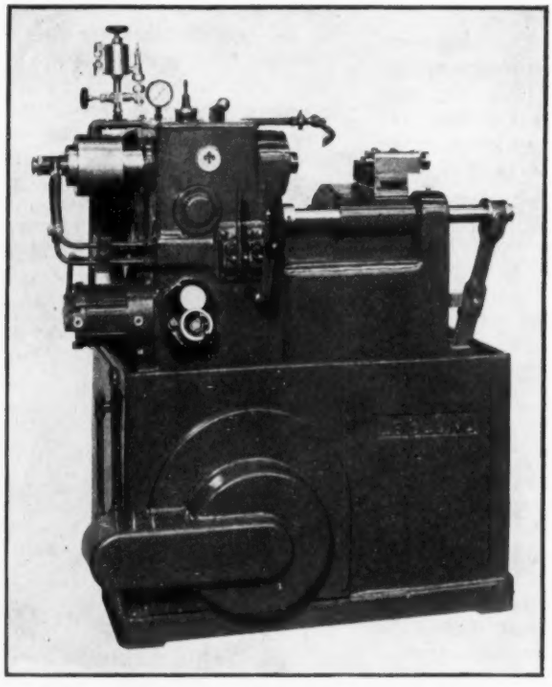
A deep-throat model of the "Do-All" continuous bandsawing and filing machine is now in production by the Continental Machine Specialties, Inc., 1301 Washington Ave., South, Minneapolis, Minn. It has a work table 21 x 21 in., and the depth of throat is 18 in. A third idler pulley is mounted on the extra deep frame of this model. The abrading band, whether the band file, narrow bandsaw or emery cloth, can be operated without this third idler wheel for doing jobs of usual size when the extra depth capacity is not needed.

The "Do-All' performs the function of internal and external precision bandsawing with narrow blade bandsaws. It is also a precision band filing machine for internal and external filing. A band polishing function permits putting a high polish on a steel surface preparatory to making a layout, making it unnecessary to do the grinding on a surface grinder. The machine may be quickly changed from one function to any other. It has infinitely variable speeds from 75 to 400 ft. per min., and speeds can be changed instantly. An air pump furnishes a jet of air at the point of the work.

"a.c.f. Berwick" Horizontal Forging Heater

American Car & Foundry Co., 30 Church St., New York, N. Y., announces an "a.c.f. Berwick" Type "C" horizontal forging heater for obtaining heat on the end of any material ranging ¼ to 1 in. or more in diameter. The work is placed between electrodes, and a heated portion one and a half times the diameter of the piece can be ob-





LeBlond special chucking lathe designed for cutting a grease-retainer groove in ball-bearing races

Continental "Do-All" continuous bandsaw, file and emery cloth machine with unusually deep throat

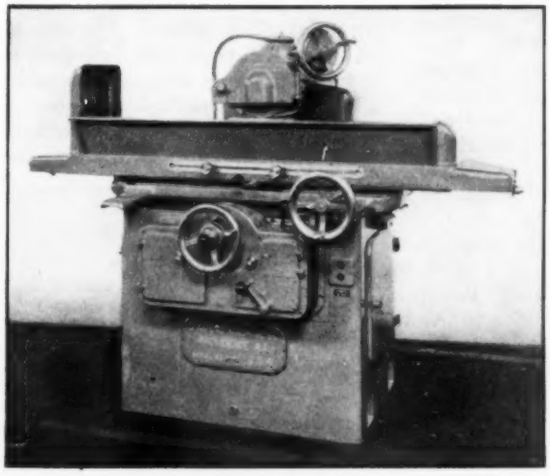
tained. Temperature is controlled by a photo-electric cell. An electric clock is provided to permit a soaking period if desired. The unit is used principally for heating the ends of material for hardening or tempering purposes, as well as for certain kinds of upset work.

Diamond Series G-824 Surface Grinders

Diamond Machine Co., 9 Codding St., Providence, R. I., is offering a line of surface grinders, known as the Series G-824, which may be used for high production as well as in toolrooms. It is equipped with hydraulic longitudinal and cross feeds, with longitudinal feeds variable from 10 to 100 ft. per min., instantly adjusted by a single speed control lever. The hydraulic cross feed has a range from 0 to 0.125 in. at the end of each stroke. Provision is also made for quick disconnecting of piston mechanism when sensitive hand operation of the table is desired.

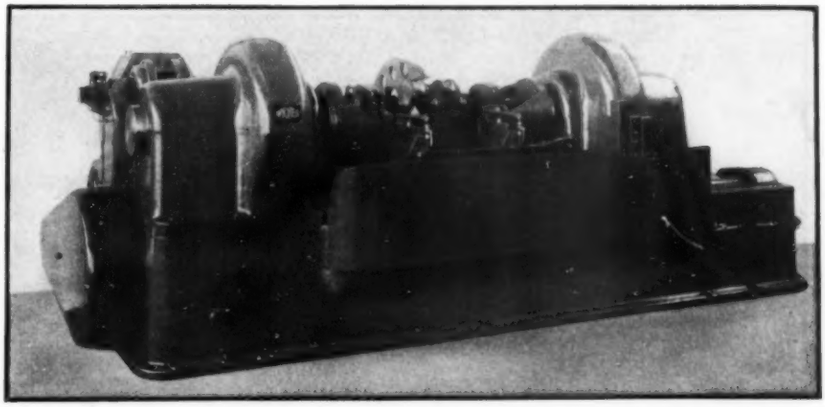
It is powered by two 1½-hp., 1,800-r.p.m. motors, one driving the main spindle at constant speed using the feed belt, the other driving the hydraulic mechanism. It is arranged for wet grinding with water pump, removable sediment tank and main tank all self-contained within the bed, and is equipped with safety devices with interlock between hand and power feeds so that both cannot be engaged at the same time. Overtravel is impossible.

The spindle is hardened and ground and has a tapered bronze bearing with positive end thrust at the front, and an adjustment for radial and longitudinal wear to hold the wheel position accurately.



Diamond G-824 Series surface grinder for production or toolroom work, with 8x24x9 in. capacity

Wickes Heavy-Duty Model DA-8 Crankshaft Lathe



Lathe for heavy diesel and tractor crankshafts developed by Wickes Bros. is entirely automatic, and takes up to eight-throw shafts

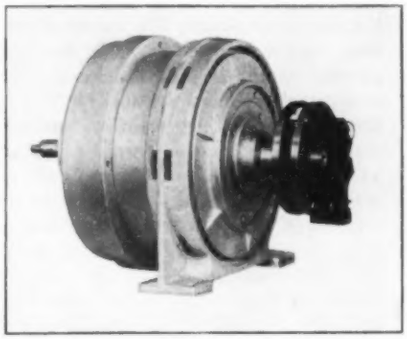
An extra heavy-duty machine designed especially for the machining of heavy diesel and tractor crankshafts has been built by Wickes Bros., Saginaw, Mich. The work cycle of this Model DA-8 lathe is entirely automatic and provides rapid traverse of tools to cutting position; coarse cheeking feed; fine turning feed; dwell, in which the cutting tools are held in a definite position for five or six revolutions of the crankshaft in order to clean up the cut; diameter stop; rapid traverse of tools to unloading position and stop in unloading position. After the operator has chucked the crankshaft, a pushbutton starts the machine which automatically goes through the cycle and stops.

Most of the bearings throughout the machine are anti-friction; the main spindle bearings are bronze boxes lined with babbitt. Forced-feed lubrication is provided throughout the entire machine. The lathe shown above is set up for checking, turning and filleting Nos. 1 and 4 crankpins on a heavy diesel crank. Additional length of lathe bed was provided in order to take in six-throw and eight-throw crankshafts. The lathe is driven by a 20-hp. variable-speed motor through multiple V-belts. The net weight of the machine, with electrical equipment is 28,000 lb. The motor is a d.c. type.

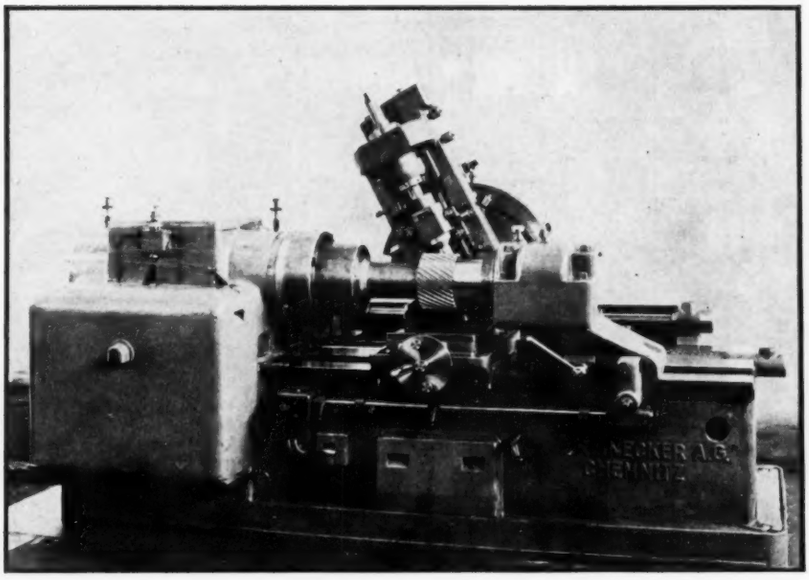
"Magnetic" Combination 24-In. Clutch-Brake

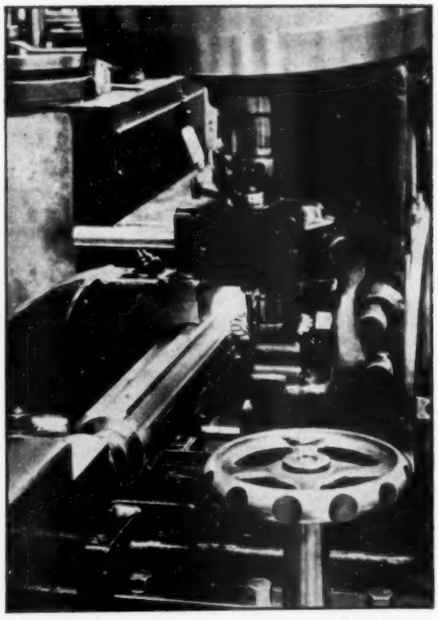
The Style "E" combination magnetic clutch-brake, recently developed by Magnetic Mfg. Co., Milwaukee, Wis., is 24 in. in diameter, developing a clutch torque of 4,500 lb.-ft. and a brake torque of 1,500 lb.-ft. It incorporates smooth acceleration, lower power-factor losses, electrical control, elimination of mechanical parts requiring repair and replacement, and gives quick, snappy, automatic stopping with positive safety at all times even if the current is interrupted.

It combines a substantial friction area to provide maximum torque with greatest heat dissipation, thus assuring minimum adjustment or replacement of the friction linings. The unit has virtually no moving or wearing parts, except the friction linings, which, it is estimated, can show more than 16,000,000 engagements and disengagements without replacement. This clutch-brake is for massive machines such as power presses, bulldozers and such similar equipment where a clutch and brake combination unit is needed.



Reinecker Heavy-Duty Spline and Pinion Hobbers





Above—Side view of head, showing machining of large splined shaft

A line of heavy-duty Reinecker spline and pinion hobbers is being placed on the American market by the George Scherr Co., Inc., 128 Lafayette St., New York, N. Y. These machines utilize modern cutting tools, and are available in three different sizes of diameter and pitch capacity. Each size can be furnished in practically every length required. The machines have been designed for either large- or small-lot production, by providing a number of standard or extra attachments. Thus, hobbing work can be done on straight multiple-spline shafts, spur pinions and gears, spiral spline shafts through a differential, spiral pinions and gears through a differential, and multiple threads through a differential. Milling of single or multiple threads by means of special cutterhead and single indexing attachment can also be done.

All of these operations, in spite of the difference in form of work involved, are essentially alike because the cutter performs the rotating cutting action as well as the traverse parallel to the axis of the work. The work itself remains stationary, except for the generating rotation motion. The machines can be furnished either as spline and pinion hobbers, with or without differential, or as thread millers only; or as a combination of both, where fully universal machines are preferred for particular requirements. A heavy adjustable follow-rest supports the work close to the cutter to prevent chatter and the cutter arbor is rigidly supported by an adjustable bearing with taper bushing.

Twelve cutter speeds are provided and changes are made by pick-off gears and sliding gearbox. The rotation of the workhead, when hobbing, is derived from the cutter drive shaft through index gears, worm and index wheel. For spiral-fluted work, a differential is inserted, which is connected to the cutter-slide feed and thus is independent of the number of teeth to be cut. When thread milling by means of single indexing, the work drive is through change gears in the rear of the bed.

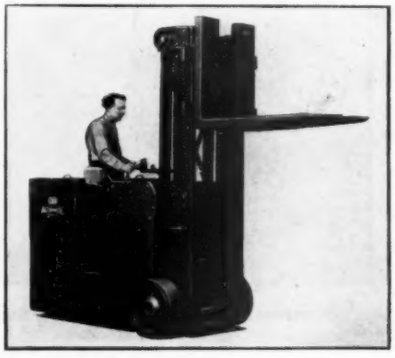
To insure maximum accuracy of spacing on the work, the driving wheel is of extremely large diameter. It is guaranteed to have no greater total accumulative tooth error than 0.001 in. The dividing worm, which is hardened and form-ground, runs in a bath of oil.

The cutter-slide drive is transmitted from the workhead drive by means of change gears located in the front of the bed. The feed is through a precision leadscrew of square thread. Power quick return to the cutter slide is provided, in addition to adjustable length stops and automatic trip upon completion of cut. The main spindle is of ample diameter with a large bore in which the work is securely clamped by a collet chuck.

The cutter-head can be swiveled in vertical plane by a worm and hand wheel. Accurate angular setting is obtained by circular scale and vernier. Optionally, a special cutter-head for thread milling is available instead of or in addition to the standard head.

"Automatic THTF" Heavy Duty Fork Truck

A heavy-duty, center-control tiering fork truck of 10,000 lb. capacity, for loads up to 72 in. long, has been developed by the Automatic Transportation Co., 101 West 87th St., Chicago, Ill. It will operate in a 94 in. intersecting aisle. Front wheel drive is provided for efficiency and tractive ability on ramps or slippery floors. The operator is fully protected and has clear vision of all operations. The capacity of this truck, along with its high stacking feature and ability to negotiate narrow aisles, enables it to increase storage space and handle heavier loads, reducing the number of trips per day.



The Round Table

CONCESSIONS FOR KICKERS

"You look worried, Al. Did you bet on the wrong horse or get the bad end in a poker game?"

"Neither, Ed. I'm giving an imitation of deeper study over a problem of discounts."

"I thought we had a no-discount policy. What's happened to that?"

"Nothing as yet, Ed. But it all seems a bit cock-eyed when you think about it carefully. I don't suppose you ever did."

"That isn't my job, Al; perhaps it's just as well. But what's it all about?"

"Well, Ed, you remember that Socker Company order we got last year? We spent a lot of money getting it; I had to go down there several times, and they cost us a lot of money one way and another."

"I remember them, Al. What about it?"

"Well, now they want another pump but demand a ten per cent discount. They say we won't have any sales cost if we take their offer, and we'll be money ahead at that."

"Something to that isn't there, Al? It might pay at that."

"I'm not so sure, Ed. They'd ask for fifteen per cent next time. And what about such customers as the Blinker Company which sent us orders for three pumps at no cost to us and never mentioned a discount?"

"They must be easy, that's all, Al."

"I don't like to look at it that way. We build a good pump and want to give good value to every customer. It isn't fair to give one customer an advantage over another. I'd a lot rather give the Blinker Company a discount, because their business didn't cost us a cent; they sent us the order out of a clear sky. I didn't make a single trip to see them."

"It looks as though it didn't pay to be considerate of the fellow you buy from, doesn't it? Kick like a steer and you get more than the man who doesn't."

"That's what I don't like about it, Ed. If we were a big concern I'd like to make some new rules about selling pumps."

"Such as what? You're always full of notions, some of them crazy at that."

"If I were doing what seems best to me, Ed, I'd set a price on pumps—f.o.b. our shop—plus the cost of selling it."

"That would never work."

"Perhaps not, Ed, but you asked for it. When a concern like Blinker sent in an order, with no expense to us, they would pay the list price. If a customer made us a lot of expense, as the Socker Company did, they would pay list price, plus the expense they caused us. Good customers would get pumps cheaper than those who make trouble, and they should. It may be crazy, and of course we can't do it, but I'd like to."

Should discounts be allowed on repeat orders? Is it sound business to favor good customers as Al suggests?

DISCUSSION

Manicuring Machines

Al's idea of employing a skilled cleaner is a distinct improvement in machine shop management. Many good, fast and accurate machinists I have had were very sloppy in removing the turning or boring chips. Some would not clean up enough so that it would be handier and easier for them to change or reset a toolbit or a cutter.

If while running on a long cut, the operator tries to tidy up his machine, well and good. However, I do not favor the half hour a week clean-up on Friday afternoon or Saturday morning. Everybody gets ready to quit fifteen to twenty minutes before the half-hour period and nearly one shop hour is lost. With an intelligent and interested machine clean-up man, work would continue until the quitting or wash-up whistle, which on a 40-hour week amounts to about 2 per cent time loss. —E. E. Gagnon.

Purchased Parts

Most concerns at some time or other find it necessary to farm out parts. Many have their jigs and fixtures made

by specialists rather than tie up capital in extensions to their toolrooms. Before deciding on plant extension, there must be taken into account the prospects for writing off a large part of the capital expenditure before another depression.

Al is looking at the problem from the financial end, while Ed, with his practical shop man's viewpoint, wants to see all the components produced in the home shop. When in doubt it is often advisable to take a middle course, which in this case would be to farm out as many of the parts as cannot be produced in the existing plant, and to make such additions as are required to the assembly section, which would require a much less capital expenditure than would an extension of the machine shop.

Ed's doubts as to outside shops being able to supply parts that are up to the required standard can be set at rest by his paying a visit to the shops of the concerns who are bidding on the work.

—W. L. WATERHOUSE,
Bristol, England.

Another Shift

Al's plan to rearrange the benches and the lathes is worth considering. In changing the benches so they will be at a right angle to the windows and forming individual benches, each man would be able to arrange his bench to suit his work and there would be no one at his side to interfere with him, as would be the case with long benches.

As to the lathes, however, there would be a few things to consider before making the suggested change, such as the type of work, production or jobbing; floor space; and the method of conveying the work to and from them and storing it while it is in progress.

On the other hand, in a jobbing shop where all types of work are done, including bar work, the lathes would have to be set so that bars projecting from the spindles would not interfere with the operators of others. Room for platforms to hold finished and unfinished work and racks for bar stock would also be necessary. If the floor space permits, the lathes should be placed diagonally with the tailstocks nearest the windows. This would give direct light on the chuck and it would be easier for the operator to see what he is doing.

—A. F. FONTANELIA.

Many shops have been operating for years with an inconvenient arrangement of machines and benches, for the simple reason that a change would cost money, where in reality the continuation of the status quo costs a great deal more. Al's idea of changing the machines and benches around is a healthy sign and, if sufficient study is given to the matter, it should result in a saving of manufacturing costs.

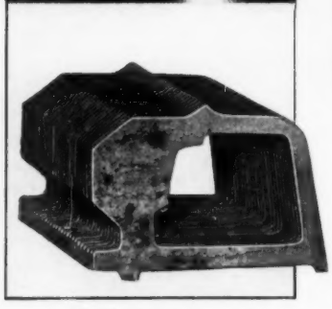
There is one item in his program that he should be careful about, and that is in arranging double benches so that the men will face each other. They will get together on a good many things besides their work and will waste time. Another result is a physical one. While Tom will be trying to file a piece very carefully to a line, using a magnifying glass, Dick may be pounding on work in his vise with a heavy hammer and interfering with Tom's work.

—EDWARD HELLER.

Five Day Week

In his discussion of this subject, W. E. Warner says (*AM*—Vol. 79, page 907) "Provided the hours worked are the same as in the six-day week, as much or more work will be turned out in the five-day week." As one who has worked in a five-day shop, I must disagree with his statement.

Side plates for paper box machine.



Machine parts cut from 3/8" plate.

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At the end of a ten-hour day one is absolutely tired out, and after five such days, the two day's break is insufficient rest. After reasonable fatigue has been incurred, further work piles up body poison at a rapidly increasing rate and real damage is done to the body. We used to say in that five-day shop that one could tell how long a man had been employed there by his face. After four weeks his face was white. Output falls rapidly after eight hours work in an ordinary factory.

—M. P. Dalton,
Dublin, Ireland.

Open House

From the viewpoint of the small shop owner, Al undoubtedly has the right slant on the toolcrib situation. A toolcrib attendant who knows his business will cost almost as much per week as a skilled machinist, and Al would probably be at his wit's end in trying to keep him busy. I believe that the hand-picked crowd Al has assembled will be able to look after any tool in the shop, because no craftsman worthy of the name ever abuses the tools of his trade.

The matter of keeping an accurate inventory of small tools is comparatively simple. I worked in one shop having a force of twelve men. The toolcrib consisted of a number of racks in one corner of the shop office. At the side of each rack was tacked a contents card containing the name of every tool in the rack, the quantity of each and when it had been issued as new.

It was the rule of the shop that tools were to be returned to the racks in good working order, and that all breakages were to be reported. Broken tools were replaced from spares that the owner kept under lock and key. A feature of this "open house" arrangement was that the men had free access to the tools and did not have to wait at a toolcrib window while the attendant served someone else.

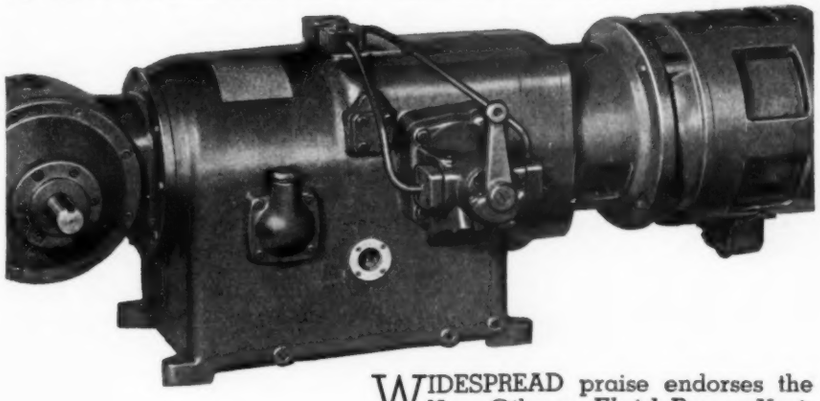
—Robert S. Alexander.

In my observation, several small shops have seemingly used Al's method of circulating small tools, but the "Baxters" of such set-ups were usually supplemented by an apprentice boy who sharpened drills and did odds and ends of non-rush production work between intervals of serving the men with tools from the toolcrib. As complex needs arose which the boy couldn't readily fill, the men came into the toolcrib, found the tools wanted for their special requirements and took them out, the boy depositing their checks in the usual way.

In addition to acting as tool-upkeep surgeons, the Baxters also had keys to the new tool lockers from which the circulating supply was replenished and new tools were exchanged for wornout or broken ones. They kept the running inventories of small tools, requested purchases of depleted stocks and spotted abnormal consumption as it began to develop, enabling corrective steps to be taken early in the game. The principal value of small tool inventory is conservatively not so much to exhibit assets as to help control expenditures, which it can do if properly utilized. It should help to keep small shops out of the red.

In the small shops referred to, the variety and the scope of the work were extreme, lot sizes small and labor turnover practically nil. The men were of the steady and responsible type and were headed by foremen of good personality. —Roland V. Hutchinson.

"THE FINEST WE HAVE EVER USED"



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DIE WERKZEUGMASCHIENEN *(Machine Tools)—by Professor Dr. Ing. G. Schlesinger. 818 pages of text and 52 tables in separate volumes bound in cloth boards. More than 1,500 illustrations. Published by Julius Springer, Berlin, Germany. Price 147 reichsmark.*

Professor Schlesinger's monumental work on machine tools represents 30 years of study and teachings. He completed his manuscript in 1935. In his foreword he says that the purpose of his book is to insure for the machine tool its place in the sun of technical knowledge.

The contents of this book can be divided into two parts: I—the elements and calculations of machine tools; II—the constructive application thereof. There would have been considerable repetition if the author had started each chapter with the elements peculiar to each machine because most machine tools have elements in common. They are therefore treated but once. The first part of the book discusses power and speed of the machines and their industrial uses. From this basis of power and speed control the entire machine can be interpreted through figures and cross sections of parts.

The second part of the book contains the application of the rules of the first part as explained by examples of the latest construction. An attempt has been made to free the text of all tiresome descriptions of single machines, to mention only the most important things, and to illustrate those with simplified line cuts so that even the student can be quickly introduced into the various sections of the field. For the technically educated man and the professional, the line drawings are included since they can be read without difficulty. It was necessary to keep each illustration separate, to make it complete with its own reference figures and explanations so that a reference to the text proper would not be necessary. This was achieved through the fact that the drawings explain first the hand adjustments (H1, H2, etc.), then the couplings (K1, K2, etc.) and their uses, then the shafts (I, II, etc.), the machine parts (*A*, *B*, etc.), the speeds (*a*, *b*, *c*, etc.), and finally the feeds (1, 2, 3, etc.), and in having these repeated in the explanation to the drawing, so that the reader, after some practice, can make use of the drawing alone since the text proper has already told him the principles.

Captions under the pictures give the necessary explanations. They explain the construction and functioning of all parts. In addition, the figure numbers of the illustrations coincide with those of the pages of the book where they appear to make checking up on the illustrations easier. Where there is more than one picture on the same page letters are added to the figure numbers.

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